NAVSHIPS 0967-219-0010

TECHNICAL MANUAL

for

TRANSPONDER SET AN/TRN-22 (XN-1)

DEPARTMENT OF THE NAVY

BUREAU OF SHIPS

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LIST OF EFFECTIVE PAGES

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
Title Page	Original	4-1 to 4-90	Original
ii to viii	Original	5-1 to 5-88	Original
1-0 to 1-16	Original	6-1 to 6-89	Original
2-1 to 2-10	Original	i-0 to i-4	Original
3-1 to 3-42	Original		

LTV Electrosystems, Inc.,
Memcor/Montek Operation
2268 South 3270 West
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Contract No.: NObsr-95003

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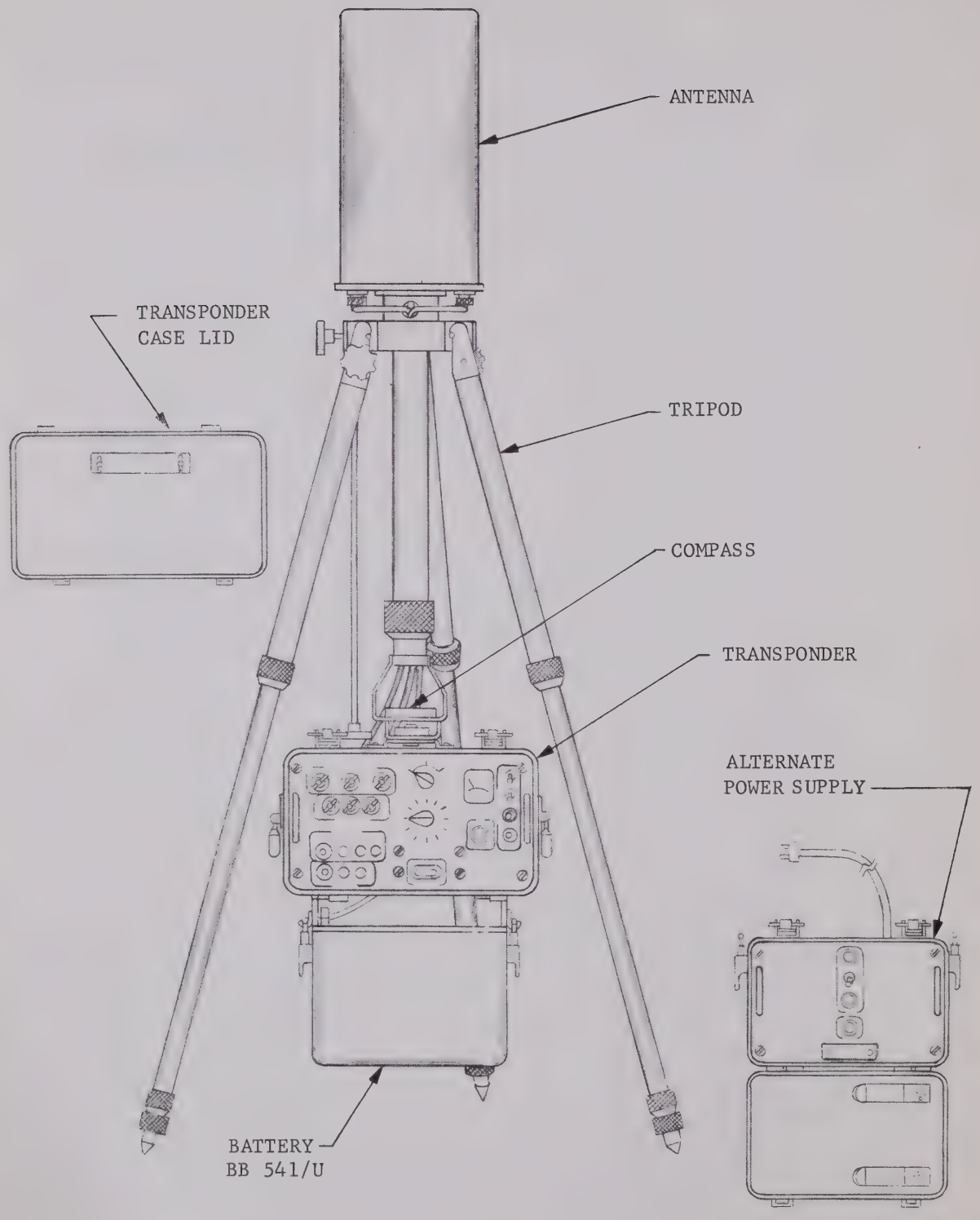


Figure 1-1. Transponder Set AN/TRN-22 (XN-1),
System Pictorial

SECTION 1

GENERAL INFORMATION

1-1. SCOPE.

This manual is in effect upon receipt and supersedes no other publication. Information included in this manual applies to only one model: Transponder Set AN/TRN-22 (XN-1). (See Figure 1-1.)

1-2. GENERAL DESCRIPTION.

Transponder Set AN/TRN-22 (XN-1) is a miniature man-transportable component of the tactical air navigation system known as TACAN. The system provides complete radio navigation information (bearing and distance) by means of r-f energy radiated from an antenna to as many as 50 aircraft simultaneously, and bearing only information to an unlimited number of properly equipped aircraft.

The unit weighs approximately 90 lb.; it can be disassembled and transported into remote areas with comparative ease by infantry personnel--previous units with similar capability have weighed many hundred pounds and required motor vehicles for transport.

The unit can be set-up for operation in 10 minutes when using the permanently attached magnetic compass. The transponder set has an operating height of from 6 to 12 feet. It has a range of 40 nautical miles. The unit will operate for 12 hours on one 24 VDC battery and will also operate continuously with a 120 volt (50 to 450 Hz) AC to DC converter.

a. INFORMATION SUPPLIED BY RADIO BEACON.- Radio beacon information determines the geographical positions of interrogating aircraft with respect to the beacon. This information consists of signal elements listed below in the order of priority established for each signal within the transponder:

(1) Angular bearing to the beacon from the aircraft, referenced to magnetic north; and

(2) Distance information, relative to the radio beacon.

These signal elements are analyzed in the following paragraphs.

b. BEARING RELATIVE TO THE BEACON.- Bearing information, originated by the radio beacon, is obtained when an angle relative to a fixed reference point (magnetic north, in this case) is determined. Bearing information supplied by the beacon is composed of two components as described in paragraphs (1) and (2) below.

(1) 15-Hz AMPLITUDE MODULATION.- A 15-Hz amplitude modulation component is imposed on the field of r-f energy radiated by the beacon antenna. (See Figure 1-2.)

(a) A conventional circular antenna pattern is shown in Figure 1-2A. Figure 1-2B shows how the same antenna pattern is affected when a fixed reflector is placed in the field of energy radiated by the antenna. The pattern becomes a cardioid, with the field r-f energy at its maximum in the direction opposite to the reflector.

(b) When the reflector rotates at a fixed rate about the radiating element of the antenna, the effect is a cardioid pattern. Figure 1-2C shows five positions of such an antenna pattern through a full 360-degree rotation of the reflector. To an aircraft due south of the radio beacon, the patterns of Figure 1-2C indicate the following signals:

1) Pattern 1 half-amplitude signal at start of rotation;

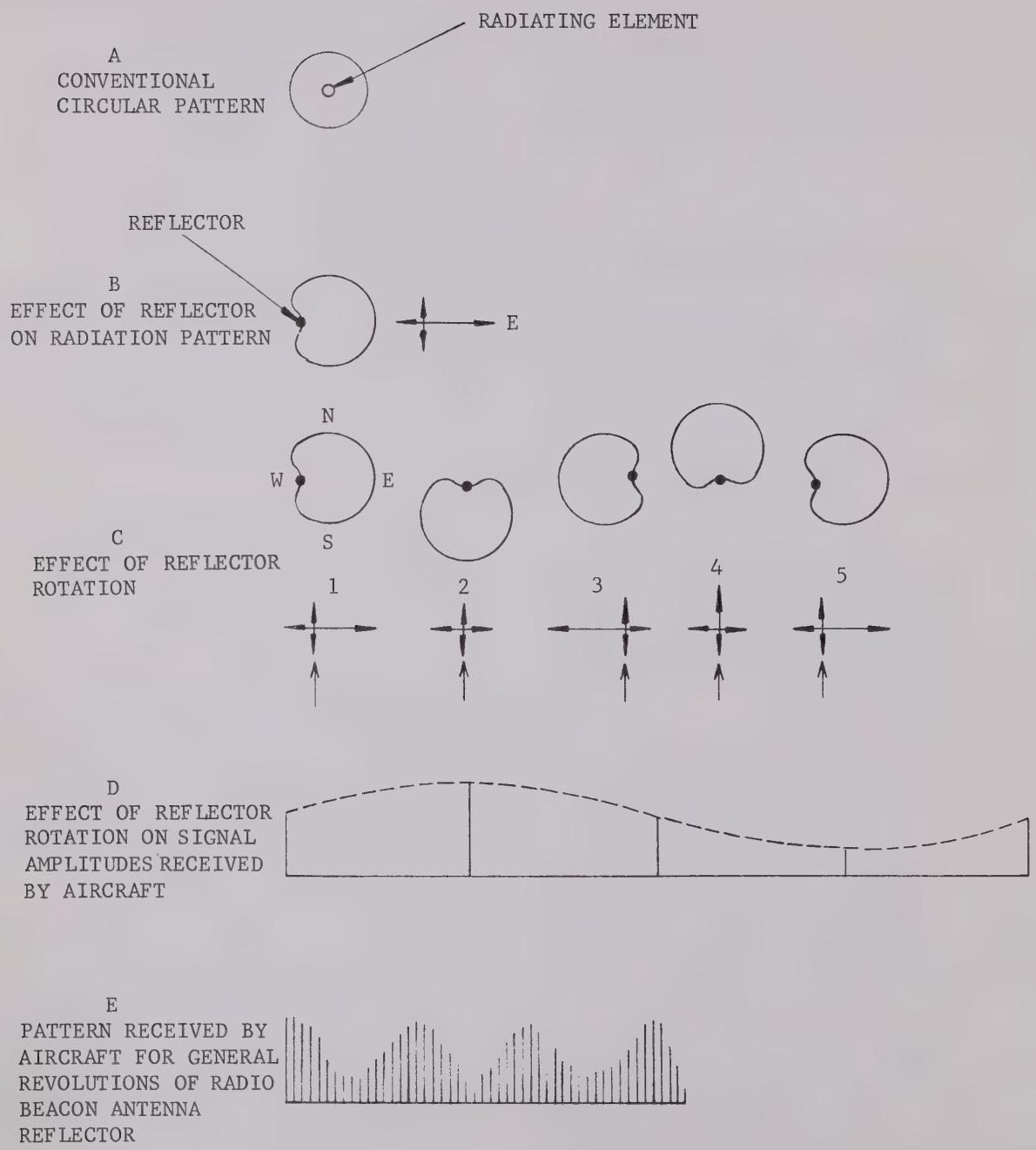


Figure 1-2. Development of Radio Beacon Antenna Radiation Pattern

2) Pattern 2 - maximum-amplitude signal as antenna rotates through 90 degrees;

3) Pattern 3 - half-amplitude signal in negative direction as antenna rotates second 90 degrees;

4) Pattern 4 - minimum-amplitude signal as antenna rotates a third 90 degrees; and

5) Pattern 5 - half-amplitude signal going in positive direction as the antenna completes full rotation of 360 degrees.

(c) The relative amplitudes of the signals received by the aircraft for one complete revolution of the antenna are shown for comparison in Figure 1-2D. Although the total beacon output is of constant amplitude through the full 360 degree rotation of the reflector, the signal received by the aircraft at any given point around the beacon varies in amplitude as explained previously.

(d) The amplitude variation of the received pulses follows a sine wave pattern (Figure 1-2E) whose frequency corresponds to the rate of rotation of the reflector around the antenna. In the case of the radio beacon, the reflector rotates about the antenna at a 15-Hz rate, imparting a 15-Hz modulation to the r-f energy radiated by the beacon. Thus, an aircraft within range of the beacon detects the complete sine wave 15 times per second.

(2) 15-HERTZ NORTH REFERENCE BURST PULSES. - To establish magnetic north as a reference point in time, a group of coded pulses is introduced into the 15-Hz amplitude modulated field of energy radiated by the radio beacon antenna. This coded burst, generated once during each revolution of the reflector, occurs every time the peak of the radiation lobe points due east. At that moment a trigger pulse generated by the antenna initiates the formation of the burst in the following manner. An aluminum disc, attached to the drive shaft of the rotating cylinder, has a thin radial slot cut in its periphery due east of the center line of the antenna when the direction of the maximum of the cardioid lobe is due north. A stationary light source and photosensor mounted close to the periphery of the disc is due south of the centerline of the antenna. Hence, once each turn of the antenna cylinder, at the desired instant, a signal is photoelectrically generated in the photosensor to trigger the transponder transmitter into sending out the specially coded reference signal.

(a) The position of the north reference burst on the 15-Hz amplitude modulated sine wave (as seen by four aircraft at four different points around the beacon) is shown in Figure 1-3. Figure 1-3A shows the position of the north reference burst on the 15-Hz modulation for an aircraft due south of the beacon (i.e., at aircraft bearing 000). Note that the burst occurs at the half amplitude point going positive, or zero degree point. Figure 1-3B shows the north reference burst for an aircraft due west of the beacon (aircraft bearing 90 degrees). The burst occurs at minimum amplitude, or 90 degree point of the sine wave. Figure 1-3C shows the position of the burst for an aircraft due north of the beacon (aircraft bearing 180 degrees). The burst occurs at the half amplitude point going negative, or 180 degree point. Figure 1-3D shows the burst at the maximum amplitude point of the 15-Hz modulation. Therefore, the aircraft is then due east of the beacon (aircraft bearing 270 degrees). This serves to illustrate how the phase of the 15-Hz modulation shifts with respect to the 15-Hz north reference burst as the aircraft moves on a 360 degree circle around the radio beacon.

(b) Any phase difference is detected by the aircraft and

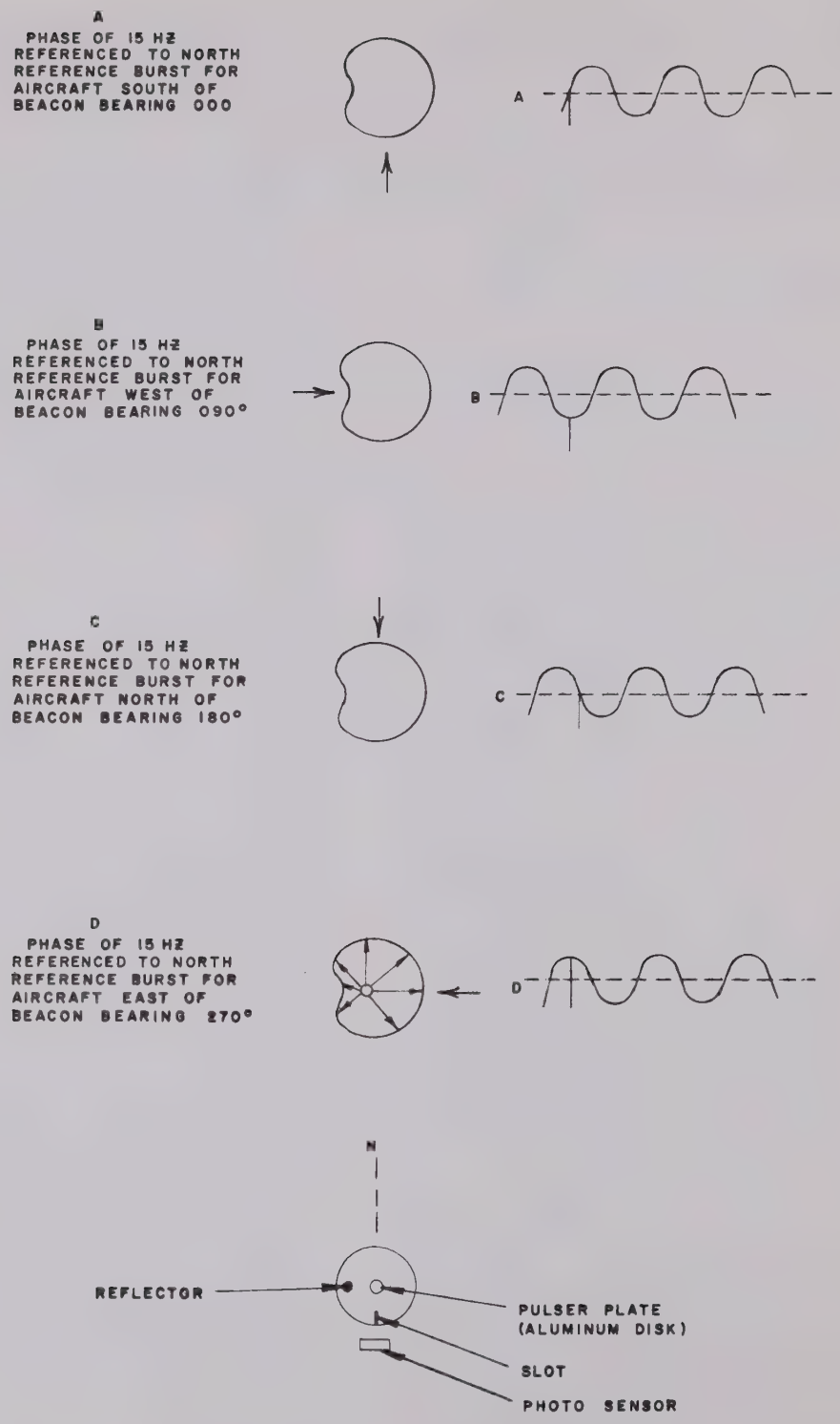


Figure 1-3. Position of North Reference Burst on the 15-Hz Amplitude Modulated Sine Wave (as seen by four aircraft from four points around the beacon)

converted to a meter reading in degrees showing the magnetic north bearing from the aircraft to the beacon.

(c) The signal (received by four aircraft located at four different points around the radio beacon) and the meter reading (that corresponds to their individual bearings) are illustrated in Figure 1-4. All four aircraft receive the north reference burst at the same instant of time, but at different phases of the 15-Hz amplitude modulation.

(3) DISTANCE MEASURING INFORMATION.- Except for the distance measuring information, all signals transmitted by the beacon are generated within the beacon. Distance reply signals are transmitted by the radio beacon only when interrogated by an airborne radio set such as the AN/ARN-52 V. This information originates in the airborne portion of the TACAN system. The airborne system transmits a sequence of paired pulses, at the r-f frequency of the radio beacon receiver and at a random rate peculiar to the particular aircraft transmitter. The beacon (capable of accepting interrogations from up to 50 aircraft) receives distance measuring interrogations, adds a 50-microsecond delay to them, and retransmits them to the aircraft as replies. This is done at the beacon's transmitting frequency and at the aircraft's receiving frequency. The aircraft's receiver performs the following functions:

(a) Selects the particular distance measuring reply. This is accomplished by comparing the repetition rate of the reply pulses with the repetition rate of the original interrogation pulses, and locking in on the particular reply pulses whose repetition rate is the same as that of the interrogation pulses.

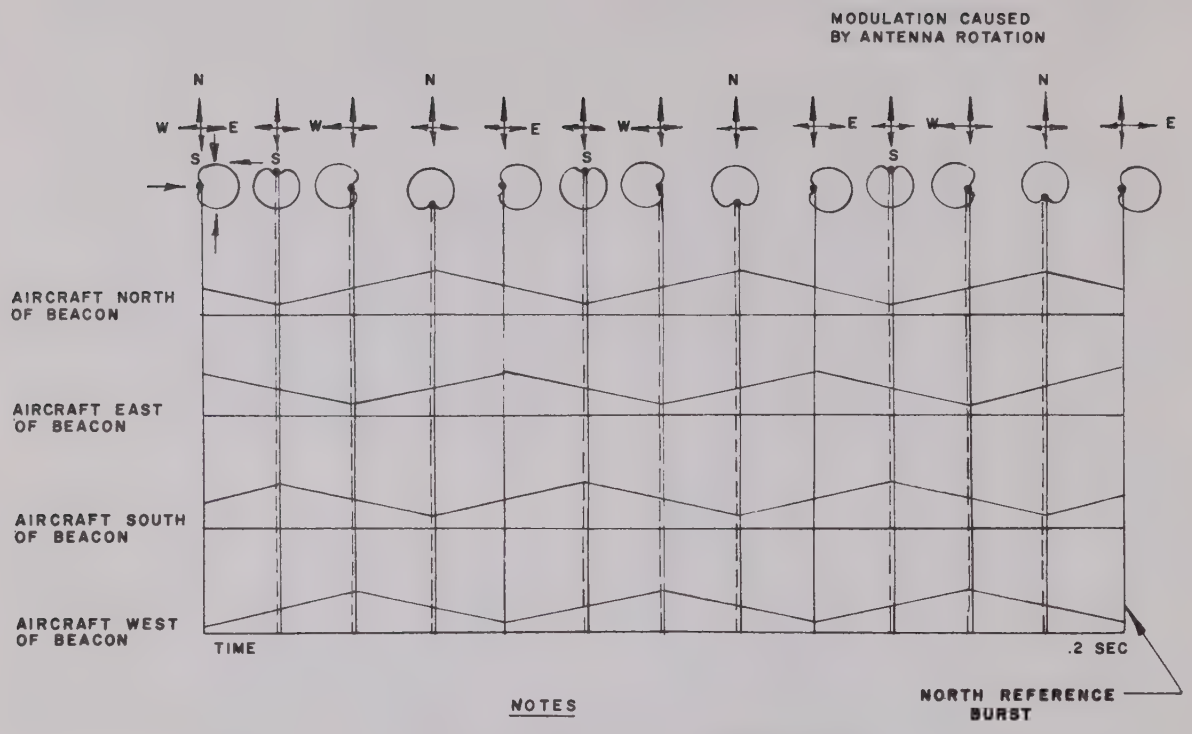
(b) Subtracts the 50 microsecond zero distance time delay and converts the remaining round trip travel time of the signal into distance between the aircraft and the radio beacon. A continuous display indicator on the airborne portion of the system displays this distance in nautical miles.

(4) INFORMATION ELEMENT PRIORITY.- The two elements of information (bearing and distance measuring information) are transmitted by the beacon as a train of pulse-pairs. The radio beacon assigns a sequence or priority in which each element enters into the over-all pulse train. This priority system prevents any interference between the two signal elements.

(a) The bearing reference burst is first in the order of priority, because it is at a fixed rate and is of relatively short duration. Accordingly, the reference burst can break in on distance measuring information being transmitted by the beacon, without significantly reducing the time available for distance information.

(b) The distance interrogation signals are second in the order of priority. These pulses are not originated within the beacon and their arrival within the pulse train must be controlled to prevent their interfering with the bearing information signal elements of the radio beacon. This is accomplished by allowing them to enter the pulse train only during a time interval that is not occupied by the reference burst signal. This is possible because the time occupied by the reference burst is small in comparison with the time allowed for the total radio beacon signal cycle. A memory circuit within the aircraft receiver compensates for the time interval during which no reply pulses are received because of the priority system within the beacon.

(c) In the absence of distance interrogation signals, random noise pulses (squitter pulses) are used as fill-in signals. These pulses are necessary to maintain the modulation



NOTES

A NORTH REFERENCE BURST IS GENERATED ONCE DURING EACH REVOLUTION OF THE REFLECTOR AND OCCURS EVERY TIME THE PEAK OF THE RADIATION LOBE POINTS DUE EAST.

HEAVY VERTICAL LINES INDICATE NORTH REFERENCE BURSTS.

AIRCRAFT MEASURES BEARING FROM A REFERENCE POINT AT THE HALF-AMPLITUDE POINT GOING POSITIVE OF THE MODULATION TO THE NORTH REFERENCE BURST.

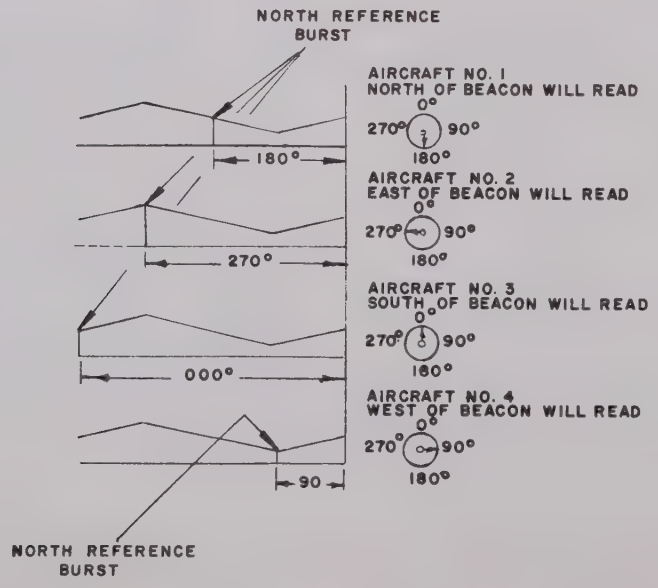


Figure 1-4. Comparison of Bearing Information by Aircraft in Different Geographic Positions Relative to the Radio Beacon

pattern and to permit constant duty cycle operation of 1530 pulse-pairs per second.

(d) The relative duration of the signal elements is such that effectively there is no interruption of bearing or distance information received by the aircraft.

(5) BEACON DUTY CYCLE.- The useful signal pulse pair contents-per second of operation of the radio beacon consists of the following signal components:

(a) 180 north reference burst pulse-pairs per second (12 pulse-pairs occurring 15 times per second).

(b) The number of distance measuring reply pulse-pairs depends upon the number of aircraft interrogating the beacon at any particular time. The maximum (for 50 aircraft interrogating the beacon simultaneously) is 1350 pulse-pairs per second.

In order to sustain the sine-wave modulation envelope of the transmitted r-f energy, it is necessary to maintain a constant total number of pulse-pairs transmitted during each signal cycle. To maintain a constant duty cycle, the beacon introduces into the signal train a sufficient number of noise-derived pulses (called squitter pulses) to bring the total number of pulse-pairs in the signal train to 1530 pulse-pairs per second. Since the reference burst pulse-pairs are constant in number, the number of noise-derived (squitter) pulses in the signal train varies inversely with the number of aircraft interrogating the beacon at any given time. Therefore, the number of squitter pulses is maximum when no aircraft is interrogating the beacon, and minimum when the maximum number of aircraft (50) is interrogating the radio beacon at one time. If more than 50 aircraft interrogate the beacon, or when the total number of distance-measuring reply pulse pairs would exceed the 1350 for which time is available, the excess number of pulse pairs is gated out. (The term "duty cycle" is expressed herein as percentage of actual transmitting time to total available time.)

(6) BEACON SIGNAL CHARACTERISTICS.- The signals transmitted by the beacon consist of pulse-pairs with a 12-microsecond spacing between pulses of a pair (12 microseconds from the leading edge of the first pulse to the leading edge of the second pulse of the same pair). The actual number of pulse-pairs per second, and the spacing between pulse-pairs, depends upon the particular signal element. The 12-microsecond spacing between the pulses of a pair distinguishes between pulses from the beacon and any other pulses received by the airborne receiver at the proper radio frequency. Signal elements (transmitted by the radio beacon) and their individual characteristics are listed below.

(a) NORTH REFERENCE BURST.- Consists of 12 pulse-pairs (with 12-microsecond spacing between pulses of a pair, and 30-microsecond spacing between pulse-pairs occurring 15 times per second).

(b) DISTANCE MEASURING REPLIES.- Consist of pulse-pairs, with 12 microsecond spacing between pulses of a pair, with spacing between pulse-pairs depending upon the pulse repetition rates peculiar to the various interrogating aircraft.

(c) SQUITTER PULSES.- Consist of pulse-pairs transmitted by the beacon in the absence of interrogations. The number of squitter pulse-pairs is determined by taking the number of interrogations received and adding squitter pulses such that the sum remains constant at 1350 pulse-pairs per second. The squitter pulse output is changed by varying the gain of the intermediate frequency amplifier within the receiver.

(7) HIGH AND LOW-BAND RADIO BEACON FREQUENCY ALLOCATION.- The radio beacon operates between 962 and 1213 MHz. This frequency range is divided into two transmitting bands and one receiving band as follows:

(a) The frequency band between 962 and 1024 MHz is used for transmission on one of 63 1-MHz channels from the radio beacon (low band).

(b) The frequency band between 1025 and 1150 MHz is used for reception on one of 126 available 1-MHz channels by the radio beacon (low and high band).

(c) The frequency band between 1151 and 1213 MHz is also used for transmission on one of 63 1-MHz channels from the radio beacon (high band).

In a beacon system the receiver and transmitter operate at channel frequencies 63 MHz apart. A beacon operating in the low band transmits at a frequency between 962 and 1024 MHz and receives at a frequency 63 MHz above the transmitter frequency (i.e., 1025 to 1087 MHz). Similarly, a beacon transmitting in the high band (1151 to 1213 MHz) receives at a frequency 63 MHz below the transmitter frequency (i.e., 1088 to 1150 MHz). Beacons are provided to operate either in the high or low band, depending on the antenna used.

1-3. DESCRIPTION OF UNITS.

a. ANTENNA.- The antenna used with the transponder is a 15-Hz, single lobe antenna and consists of a stationary central array, a rotating parasitic reflector element, an antenna drive motor, and a protective radome. The antenna is mounted on a tripod and can be adjusted to a maximum height of 12 feet above ground.

(1) The antenna receives distance interrogation signals from the airborne equipment and radiates distance reply signals. The antenna also radiates bearing and north burst reference signals. The rotating reflector element revolves at 900 rpm in order to modulate the transmitted signal at 15 Hz.

(2) The antenna for the AN/TRN-22 (XN-1) is designed for transmission and reception of signal in the low band only.

b. TRANSPONDER.-

(1) GENERAL.- The component units containing the transmitting, receiving, coding, timing, monitoring and power supply units are mounted on a rack-frame and are arranged into a panel drawer unit to facilitate servicing. The drawer unit is in turn mounted in an electrical equipment cabinet.

(a) The drawer-type panel and chassis assembly is arranged to be removable from the cabinet. When fully inserted in the cabinet, the drawer is secured to an inner frame by captive screws. To remove the drawer, release the captive screws and pull on the panel-mounted handles. Interunit cabling connections to the drawer are made by plug-in screw-type connectors. No solder connections exist in the interunit cabling.

(b) The transponder has a built-in power supply located at the rear of the chassis. Primary power to the unit is brought through an interlock mounted at the rear of the chassis. This interlock is so arranged that opening the unit disables power to the unit; thus, disabling the over-all system. To permit the unit to be serviced when open, the interlock can be set in a "cheated" position.

(c) The operating controls, switches, indicating lamp, meter, fuses and major controls and minor tuning adjustments are located on the subassem-

blies and individual chassis behind the front panel.

(d) The transponder consists of the receiver, level detector decoder, automatic rep rate control circuit, control circuit, encoder/modulator, r-f oscillator, transmitter frequency multiplier chain, L-O frequency multiplier chain, r-f power amplifier power supply and monitor/tuning circuitry.

(2) RECEIVER.- The receiver performs the following functions:

(a) Receives from the antenna the interrogation pulse-pairs transmitted by the aircraft;

(b) Converts the received distance interrogation pulse-pairs, along with random noise pulses generated within the mixer and the i-f amplifier into an intermediate frequency of 63 MHz, and amplifies and demodulates these signals; and

(c) Maintains (by controlling i-f amplifier gain) a constant output at 1350 ±135 pulses per second of the decoder, regardless of the interrogation rate.

The receiver includes the following:

(a) Preselector

(b) Low-pass filter

(c) Balanced mixer

(d) i-f amplifier

(e) Ferris discriminator

(f) Video amplifier

(g) Automatic Sensitivity control (ASC).

1) PRESELECTOR.- The preselector provides proper preselection of the receiver frequency to suppress sufficiently the image frequency and spurious frequencies. The preselector is located at the front end of the receiver. It consists of three individually tunable cascaded cavities and is tuned via three front panel controls. A graph is provided in this manual (See Figure 3-15a) for appropriate setting of the controls.

2) LOW-PASS FILTER.- The low-pass filter provides at least 50 db rejection to interfering r-f signals above 1650 MHz.

3) MIXER.- The mixer is a balanced-type mixer. The local oscillator signal is fed into one arm of the mixer and the interrogation pulse-pairs are fed into the other arm. The resultant intermediate frequency (63 MHz) is amplified in the logarithmic i-f amplifier.

4) I-F AMPLIFIER.- The i-f amplifier raises the interrogation pulses and random noise pulses, at the intermediate frequency appearing at the output of the mixer, to a level sufficient to operate the Ferris discriminator. The gain characteristic of the i-f amplifier is logarithmic rather than linear. This allows the amplifier to amplify a much wider dynamic range of input signal levels than a conventional linear amplifier.

5) FERRIS DISCRIMINATOR.- A Ferris discriminator is used to convert the interrogation pulses from the modulated i-f signal to a video signal. In addition, the Ferris discriminator provides the necessary adjacent channel rejection not obtainable by the i-f amplifier alone.

6) VIDEO AMPLIFIER.- The video amplifier receives the detected i-f amplifier output signal, noise and interrogation pulses, and further amplifies the video signals to a level that can operate the coincidence-type decoder.

7) AUTOMATIC SENSITIVITY CONTROL (ASC) CIRCUIT.- The automatic sensitivity control circuit controls the gain of the i-f amplifier. Decoded interrogation and noise pulses are fed to an integrator which converts the number of decoded pulse-pairs into a DC voltage. This DC voltage is compared by means of a differential amplifier with a reference voltage. If both voltages are not equal in amplitude, an error signal is generated which in turn controls the gain of the i-f amplifier. That means that the ASC circuit maintains the number of the decoded pulse-pairs constant regardless of whether they are originated by an interrogation of an aircraft or by receiver noise.

(3) LEVEL DETECTOR.- The logarithmic i-f amplifier compresses the r-f input pulse. Since timing is based on the 50 percent pulse amplitude of the leading edge of the original Guassian pulse, the 6 db or 50 percent pulse amplitude always occurs at a fixed voltage difference from the peak of the video pulse.

(a) The purpose of the level detector is to generate a pulse of constant amplitude when a pulse attains its so-called 6 db down point. This requires that the signal be processed in two channels, A and B. Channel A detects the peak of the video signal, subtracts 6 db of the peak magnitude and stores this information. In Channel B the video pulse is delayed by a delay line for 3 microseconds and is applied to a coincidence circuit. As soon as the delayed signal in Channel B reaches the 6-db-down point of the signal in Channel A, the coincidence detector generates an output pulse which is in turn processed to the decoder.

(b) The blanking gate is incorporated into the circuit of the level detector. It receives its actuating signal from the modulator and inhibits the signal from being processed to the level detector during periods of beacon r-f transmission.

(4) DECODER.- The decoder produces a single pulse for each input pulse-pair received from the level detector having pulses separated by 12 microseconds. It is important that the transponder responds to a single interrogation pulse-pair with one and only one reply pulse-pair. Multiple replies to a single interrogation can result in serious distance measurement errors. This problem is dominant in mountainous areas as a greater percentage of properly coded interrogation signals can arrive via indirect routes due to the presence of more reflecting surfaces.

(a) Signals which arrive within the transponder dead time are suppressed by the dead time gate which is applied after each properly decoded pulse-pair. In general, echoes arriving at the transponder after the transponder dead time has elapsed are attenuated to a level below the receiver decision level as such echoes have traveled farther and have bounced off various types of surfaces. High level echoes reflected over a short distance, however, can severely distort directly received interrogation pulses. The echo pulses may add to or subtract from direct pulses. Echoes originating from a common interrogation always arrive at the receiver some time after reception of the first pulse of the direct pulse-pair.

(b) Generally, TACAN decoders utilize the leading edge of the second pulse of interrogation pulse-pairs for range measurement timing. In doing so, significant errors in distance measurement can result due to the presence of pulse distorting echoes. For this reason, the decoder of the AN/TRN-22 (XN-1) uses the leading edge of the first pulse in a pair for timing purposes and the second pulse of the pulse-pair for decoding purposes.

(5) AUTOMATIC REP-RATE CONTROL (ARRC).- When the AN/TRN-22 (XN-1) receiver is jammed by a CW signal, squitter pulses are no longer generated in the receiver. But, it is very vital that the transponder set continue to transmit the 15-Hz bearing information. In this case the ARRC circuit automatically takes over the generation of the squitter pulses. An internal feedback loop maintains the squitter pulse rate constant at 1350 ±135 pulses per second. An inhibit gate is incorporated into the ARRC circuit. It is actuated by the dead time gate generated in the control circuit. The purpose of the dead time gate is to prevent acceptance of any interrogation or noise pulses for a period equal to that of the dead time of 20 to 65 microseconds after a pulse has entered the control circuit. This time allows sufficient recovery time in the units constituting the transmitter.

(6) CONTROL CIRCUIT.- The control circuit performs the following functions:

(a) Generates a 15-Hz north reference burst each time a 15-Hz trigger pulse is generated in the antenna;

(b) Processes both the decoded distance interrogation pulses and the squitter pulses, and, in combination with time delays in the receiver, decoder and transmitter, adjusts their net transit time through the beacon to 50 ±0.25 microseconds;

(c) Assigns priority of transmission to the north reference burst signal over interrogation and squitter pulses;

(d) Generates receiver dead time gate; and

(e) Provides north reference burst pre-gating, thus preventing occasional receiver signals from occurring within 20 microseconds of the transmission of the first pulse of the 15-Hz north reference burst.

(7) ENCODER AND MODULATOR.- The encoder circuit receives trigger pulses from the control circuit and encodes and identifies them as TACAN radio beacon signals. Each pulse is converted into an approximately shaped Gaussian pulse pair and superimposed on a pulse pair pedestal. The modulator section receives the properly shaped pulse pairs and provides the power necessary to modulate the r-f power amplifier.

(8) R-F OSCILLATOR.- The r-f oscillator is a crystal controlled oscillator tunable over a wide frequency band. The module contains oscillator and amplifier stages. The oscillator may be tuned on any of 126 crystal frequencies by installing the desired crystal and tuning by means of a front panel screwdriver adjustment for a maximum front panel test meter reading.

(9) TRANSMITTER FREQUENCY MULTIPLIER CHAIN.- The crystal oscillator generates a signal in the range from 38 to 44 MHz. The oscillator frequency is multiplied by two doublers and a harmonic generator in the multiplier chain. The output signal of the harmonic generator is coupled into a resonant cavity that is tuned to the 6th harmonic of the incoming signal (the 24th harmonic of the oscillator frequency) for low band operation (962 to 1024 MHz); it may be tuned to the 7th harmonic of the incoming signal (the 28th harmonic of the oscillator frequency) for high band operation (1151 to 1213 MHz). The final amplifier stage of the chain is gated on during transmission. This gating reduces the DC power consumption. The output signal of the transmitter frequency multiplier chain is applied to the r-f power amplifier.

(10) LOCAL OSCILLATOR FREQUENCY MULTIPLIER CHAIN.- A portion of the signal is tapped off the second r-f amplifier stage of the transmitter

multiplier chain and multiplied through a second modified frequency multiplier chain for use as the transponder receiver local oscillator signal. Frequency tuning is accomplished from the transponder front panel.

(11) R-F POWER AMPLIFIER.- The r-f power amplifier consists of three cascaded L-band tube/cavity amplifiers: preamplifiers V_1 and V_2 and final amplifier V_3. All three tubes operate in grounded grid mode. The r-f input signal is coupled to the cathode of tube V_1. Pulse-pair modulation of the r-f signal is accomplished by applying the video signal from the modulator to the cathode of the first and second tube. The final tube, V_1, is biased cut-off and operates in class-C mode.

The overall gain of the r-f power amplifier is approximately 30 db.

c. BATTERY.-

The transponder set including the antenna drive operates from a silver-zinc 24 V (nominal) BB-451/U type rechargeable storage battery capable of operating the beacon for about 12 hours. This battery is clamped directly to the bottom of the transponder.

d. ALTERNATE POWER SUPPLY.-

(1) The alternate power supply can be used in lieu of a battery. It provides an unregulated, but filtered, DC output of 25 V nominal. This power supply can operate from a power source of 50 Hz to 450 Hz and 120 V ± 10 percent single phase. It is clamped to the transponder in the same manner as the battery. A DC adapter cable can be used to connect power between an external unregulated DC source and the transponder set. The cable is provided with connectors mating with the power input connector of the transponder.

(2) The power supply in the transponder consists of two main parts—the voltage regulator and the DC to DC converter.

(3) The voltage regulator circuit provides a constant voltage source independent of variation of the input voltage and variation of the load resistance.

(4) The purpose of the DC to DC converter is to efficiently convert the DC output of the voltage regulator to DC voltages of different levels. The load of the converter is practically constant; hence, for constant (regulated) input voltage the output voltage is also constant.

1-4. REFERENCE DATA.-

a. TRAFFIC CAPACITY.- The equipment is capable of providing distance measuring service to 50 interrogating aircraft and 15-Hz bearing service to an unlimited number of aircraft.

b. TRANSMITTER POWER OUTPUT.- The r-f peak power measured at the transponder carrying case external connector is not less than 100 watts at the desired channel. There is not less than 30 db attenuation of interference to adjacent channels.

c. TRANSMITTER OUTPUT PULSE SHAPE.- Transmitted pulses are approximately Gaussian in shape, with a duration of 3.5 ±0.5 microseconds, and are paired with a pulse-pair spacing of 12 ±0.25 microseconds.

d. TRANSMITTER PULSE REPETITION RATE.- In addition to the reference pulse group, the signal has a randomly distributed pulse repetition rate which is maintained at 1350 ±135 pulse-pairs per second before the 15-Hz north reference group is added to the signal; the random rate may include distance replies. The distribution of the random pulse spacing for no interrogation load falls within the limits shown in Figure 1-5, for a dead time of 60 microseconds. The

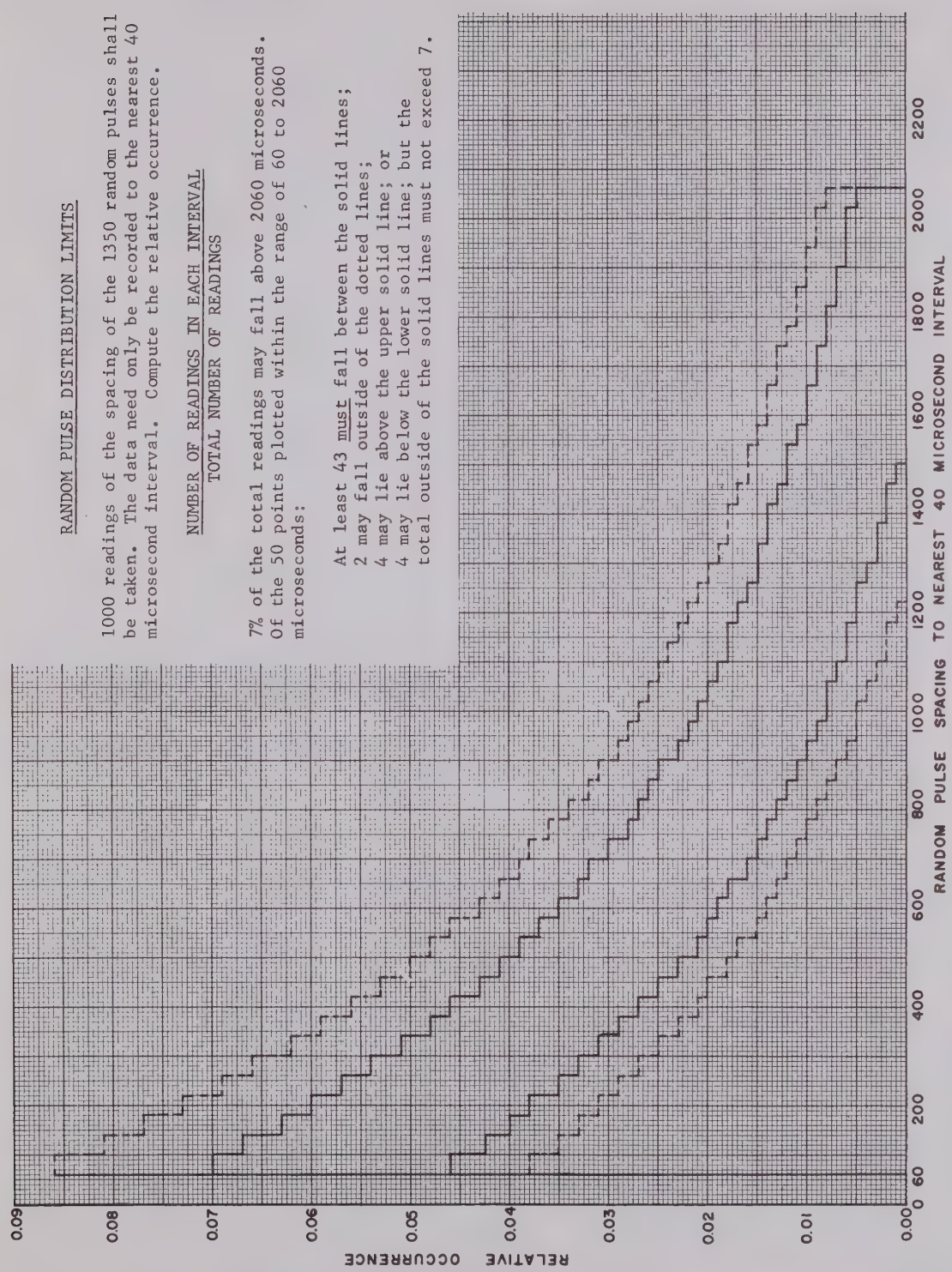


Figure 1-5. Random Pulse Distribution Limits

pulse repetition rate is constant, within the limits cited above, for all conditions of CW jamming.

e. TRANSMITTER PULSE COUNT LIMITING.- Pulse count limiting is an automatic temporary limitation of transponder replies to protect the transmitter from overload in the presence of excessive interrogations. From zero to full load, pulse count limiting is effective to maintain the average number of transmitted pulses constant to within ±5 percent.

f. TRANSMITTER REPLY FREQUENCY.- The transmitter frequency is 962 MHz to 1024 MHz, and 1151 MHz to 1213 MHz. The equipment is tunable to any one of the 126 frequency channels centered on integral frequencies in the range listed above and specified in paragraph 2.1.1.2, MIL-STD-291A.

g. TRANSMITTER FREQUENCY STABILITY.- The transmitter oscillator frequency stability is maintained within ±0.005 percent of its specified frequency.

h. 15-HZ REFERENCE BEARING SIGNAL.- The 15-Hz north reference bearing signal is in accordance with paragraph 3.5, MIL-STD-291A.

i. RECEIVER FREQUENCY.- The receiver is tunable from 1025 MHz to 1150 MHz to any one of the 126 standard TACAN channels specified in paragraph 2.1.1.1, MIL-STD-291A.

j. RECEIVER FREQUENCY STABILITY.- The receiver does not drift more than ±100 KHz from the assigned receiver channel frequency.

k. RECEIVER BANDWIDTH.- The receiver bandwidth is such that the triggering level does not deteriorate by more than 3 db when its total drift is added directly to an incoming frequency drift of ±100 KHz.

l. RECEIVER SELECTIVITY.- The receiver receives signals prescribed in paragraph 4, MIL-STD-291A, on the tuned channel frequency. The receiver rejects properly coded interrogation on adjacent channel 65 db above the threshhold level of a properly coded interrogation signal in the passband. Signals arriving at an intermediate frequency are suppressed 80 db. All other spurious responses within the 960 to 1215 MHz band including the image frequency are suppressed 65 db.

m. RECEIVER TRIGGERING LEVEL.- The receiver receives at a response percentage of not less than 60 percent, properly coded interrogations 120 db below 1 watt, measured at the input connector of the receiver module under no load conditions. The total number of pulses out of the receiver is 1350 ±135 pulse pairs per second for conditions of normal loading and up to 5 percent overload. The sensitivity of the receiver does not decrease more than 3 db when receiving a pulse pair spaced 0.5 microsecond from nominal nor less than 40 db for a pulse pair spacing of 4.0 microseconds from nominal.

n. POWER SUPPLY.- The transponder set, including the antenna drive, can be operated from:

(1) BB-451/U type battery, 24 V nominal 12 hours minimum operating time;

(2) Alternate power supply for operation from an alternate power source of 120 V ±10 percent, single phase, 50 to 450 Hz, 60 W, 0.8 pf; or

(3) Outside unregulated but filtered 26 VDC (nominal) power source, 1.5 ADC at 25° C.

o. ANTENNA.- The antenna receives distance interrogation signals from the airborne equipment and radiates distance reply signals. The antenna also radiates 15-Hz bearing and north burst reference signals. (See Figure 1-3)

The antenna array is vertically polarized, and is capable of transmission in the lower band from 962 to 1024 MHz and reception in the band from 1025 to 1087 MHz. The gain at the horizon in the frequency range from 960 to 975 MHz is at least 0.5 db and the gain in the frequency range from 976 to 1024 MHz is at least 1.75 db over an isotropic radiator. The maximum carrier energy is radiated above the plain perpendicular to the axis of the antenna. The carrier amplitude at an angle of 45 degrees below the maximum carrier amplitude in this included angle.

The impedance of the antenna is 50 Ω and the voltage standing wave ratio (VSWR) is less than 2 to 1 measured at the transponder end of the normal antenna feed cable.

The north reference trigger pulse is synchronous with the rotation of the parasitic reflector element. The rotational speed of the reflector element is 900 rpm ±1% through extremes of power source variation and operating temperature.

The antenna is supported by a lightweight tripod so that the top of the antenna will be at least 6 feet above the ground and can be extended to a maximum height of 12 feet above ground.

A weatherproof, induction-damped magnetic compass with a level is mounted at the base of the center post of the antenna tripod. Under normal conditions, the total siting error resulting from the use of the compass does not exceed 1 degree.

Note

The antenna provided operates in the low band only.

The transponder is capable of transmitting and receiving signals at the high band (1151 to 1213 MHz transmission, 1088 to 1150 MHz reception) if a high-band antenna is used.

TABLE 1-1. EQUIPMENT SUPPLIED

QTY PER EQUIP	NOMENCLATURE		OVER-ALL DIMENSIONS (IN.)			VOLUME (CU FT)	WEIGHT (LB)
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
1	Antenna	1A1	15.5	7.5(dia)	-	0.50	9
1	Transponder	1A2	10.25	14.0	10.0	1.01	28
1	Alternate Power Supply	1A3	7.0	11.0	10.5	0.46	18
1	BB-451/U Battery with Adapter and Electrolyte	1A4	9.25	11.5	4.75	0.29	16
1	Tripod and Compass**	1A5	45.5	9.5(dia)*	-	2.38	34
2	AN/TRN-22 (XN-1) Manuals	NAVSHIPS 0967-219-0010	11	8.5	-	-	-

*In carrying position. **Includes cabling and carrying case.

SECTION 2

INSTALLATION

2-1. UNPACKING THE EQUIPMENT.

a. Components and accessories of Transponder Set AN/TRN-22 (XN-1) (See Table 1-1) are packed in two wooden crates. The tripod, compass and antenna are packed in one box; the transponder, alternate power supply, and battery are packed in the other. When the equipment is received, uncrate it in an orderly manner, one component at a time.

b. Use a nail puller to remove the nails from the top of the crates. When using a pry bar to help any uncrating operation, be very careful with the cases, components, or any other contents of the crate.

c. Carefully inspect all unpacked equipment for damage.

2-2. POWER REQUIREMENTS.

The power input requirement for the Transponder and antenna is 24 V +5 V, -2 V DC, 1.5 amperes maximum current drain. The power input requirement for the alternate power supply is 120 volts ±10%, 50 to 450 Hz, 60 watts, 0.8 power factor (minimum), 0.7 amperes maximum current drain.

Warning

Only a floating external DC power source shall be used. This means neither B plus nor B minus shall be grounded. Otherwise a damage of the DC power source or of the transponder voltage regulator can occur.

2-3. SITING CONSIDERATIONS.

a. The antenna for the AN/TRN-22 (XN-1) unit is designed so that its maximum height will be no more than 12 feet above ground. In fact, operation of the antenna at the minimum height (6 feet) will be even preferable, as far as vertical reflection effects are concerned. This is particularly true when the ground over which the antenna is installed is smooth and free of ground undulations exceeding a few inches in dimensions such as are found on most airports. The transponder set antenna has the further advantage of vertical polarization, a characteristic of TACAN.

b. Radio ranges for years have been plagued with problems which develop from ground reflections. Horizontally polarized signals are most susceptable to deep interference regions. The number of such regions encountered increase with the height of the antenna above ground.

c. Original TACAN antennas were intended for operation from the top of aircraft carrier masts. The height of such locations is very great electrically. In fact such heights produce many interference regions per degree of elevation angle. In order to keep the signals from descending into very deep nulls, as much up-tilt as possible was designed into the antennas. The extent of the up-tilt was limited only by what was considered a maximum height of antenna elements for practical use. Much more up-tilt would have been used if larger antennas had been acceptable.

d. In the case of the height limitation of the AN/TRN-22 (XN-1), a very powerful reflection reduction effect, Brewster Angle Effect, comes into play to the great advantage of reducing ground reflection interference effects.

e. At the maximum height of the AN/TRN-22 (XN-1), 12 feet, the first interference region forms at an elevation angle of about 2.4 degrees. At increasing angles of incidence from 0° approaching the region of 3 to 5 degrees, vertically polarized signals experience very poor reflections from ground surfaces. These effects depend on ground conductivity and this in turn depends on moisture and chemical content of the soil.

f. Figure 2-1 shows an average soil characteristic for reflections of vertically polarized signals. Two curves are shown; one gives the coefficient of reflection and the other gives the phase shift produced by the reflection. The latter changes with angle of incidence about half as fast as the coefficient of reflection. For angles as low as 2.4 degrees, a first approximation may be made by neglecting the phase shift.

g. At 2.4 degrees, the coefficient of reflection as shown in Figure 2-1 has a value of about 0.38 units. This means that the reflected signal is only 0.38 units as strong as the incident signal. If the antenna were designed with no slope in its radiation characteristic, the signals directed 2.4 degrees above the horizon and 2.4 degrees below the horizon would be equal. However, as pointed out above, the signal which is directed to the ground at 2.4 degrees and then reflected upward at 2.4 degrees has an amplitude of only 0.38 compared to its original amplitude. When this reflected signal combines with the direct signal, it will leave a resultant signal of 0.62 units. This is based on the assumption that no phase shift occurs in the reflection. Since some phase shift does occur, the resultant 0.62 unit signal is pessimistic since the two signals do not subtract directly.

h. At the first maximum above the ground (1.2 degrees) for an antenna height of 12 feet, the reflected signal is seen to have an amplitude of about 0.68. This, combined with the direct signal gives a result of 1.68, again neglecting phase shift.

i. The two resultants provide a means of determining the depth of the null with respect to the first maximum above the horizon. The ratio in db is 20 log 1.68/0.62 = 20 x 0.433 db = 8.66 db, therefore, 8.7 db.

j. When the slope of the antenna radiation is included in these calculations, the difference between lobe and null signals is still further decreased. Consider the carrier curve shown on Figure 2-2. At 2.4 degrees above and below the horizon, the signals have 88.4 units and 81.6 units respectively. The 81.6 units are reduced by the factor of 0.38 in the reflection, giving a value of 31.0 units. This quantity subtracted from 88.4 units leaves 57.4 units of signal in the null. At 1.2 degrees above and below the horizon, the carrier curve has values of 86.7 units and 83.3 units. In the reflection, the 83.3 units are reduced by a factor of 0.68 giving a reflected value of 56.6 units. This value added to 86.7 units gives 143.3 units of signal in the lobe. The ratio between these two in db is 20 log 143.3/56.6 = 20 x 0.403 = 8.06 db. This shows that the antenna slope has further decreased the depth of the null.

k. On shore sites, reflecting objects such as buildings, wires, trees, and so forth are so much a part of every antenna environment that they are almost sure to be illuminated. Since this is the case, reflections from vertical objects are always present to greater or lesser degrees. When the reflected signals from these vertical objects are strong, they seriously interfere with direct signals from navigational aids making system performance unusable.

l. In most cases, when some care

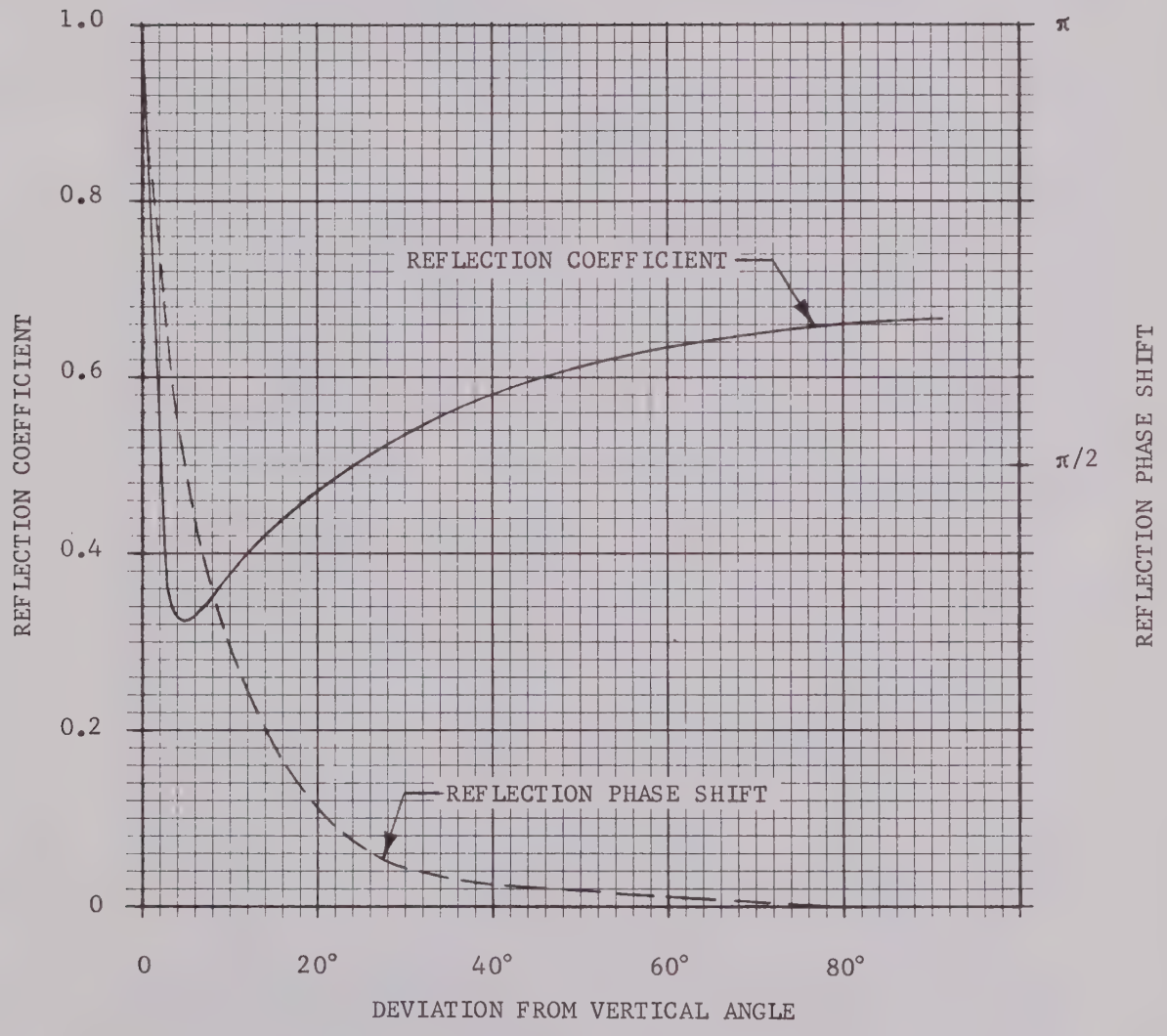


Figure 2-1. Average Soil Characteristic for Reflections of Vertically Polarized Signals

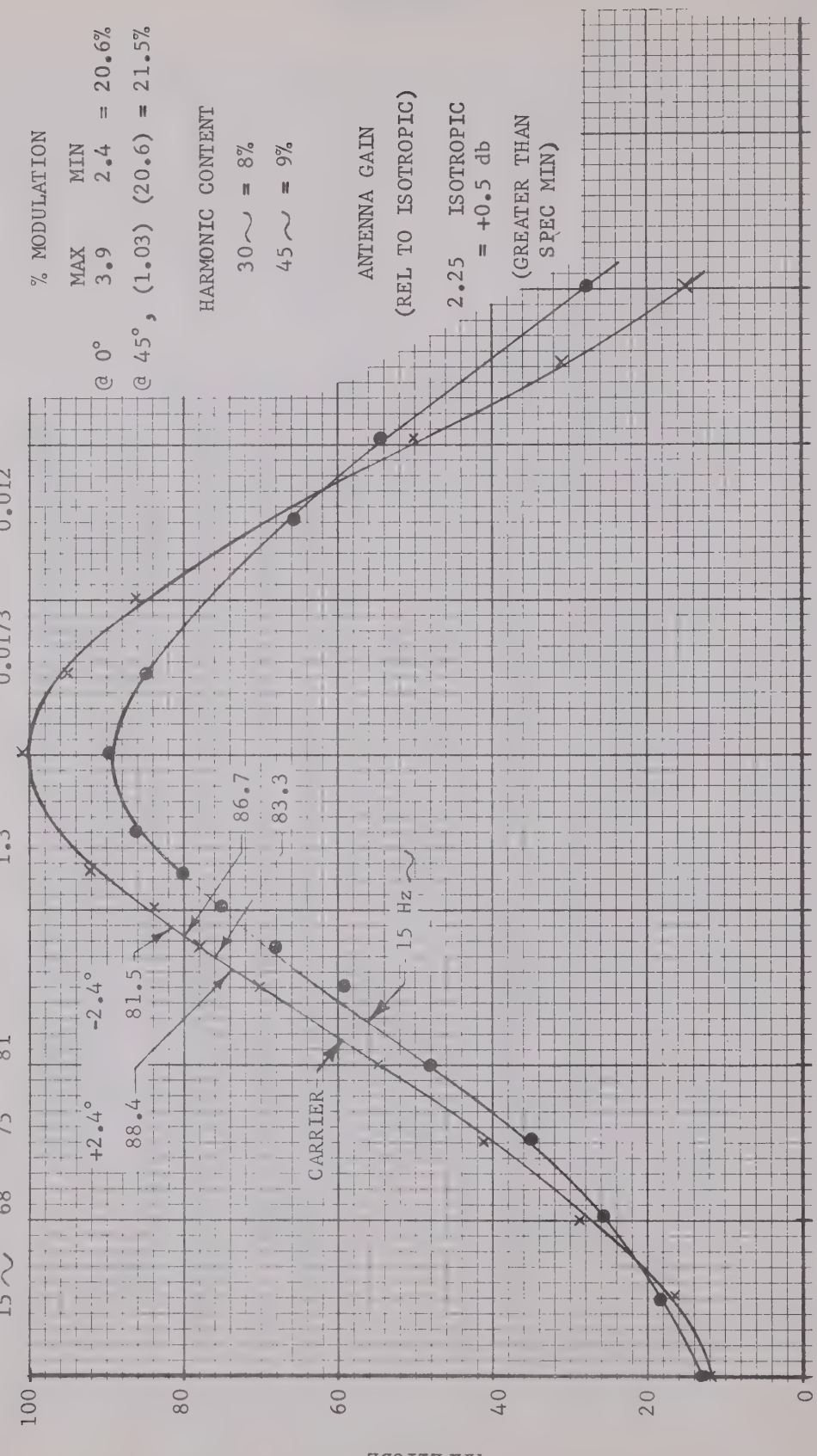


Figure 2-2. Comparison of Amplitude and Vertical Angle for Carrier and 15 Hz Modulation

care is taken in site selection to avoid illumination of vertical reflecting objects, performance of the navigation signals is generally satisfactory.

m. However, when deep nulls are produced in the direct signals due to good ground reflections, the undesired signals reflected by vertical objects which are nearly always present will exceed the greatly diminished direct signal in strength thereby causing bearing errors and search cycles in the airborne equipment.

n. Preliminary studies have indicated that when the nulls in the direct signals are not more than about 10 db in level below the lobe signals, performance obtained from navigational aides in fair to good sites will generally be satisfactory. More work needs to be done on this subject to make maximum use of the Brewster Angle reflection effect. Certainly, lesser null depths will give even better performance.

o. It was pointed out above that when the antenna is 12 feet above ground (See Figures 2-3a and 2-3b) the first null above the horizon occurs at 2.4 degrees and the first lobe occurs at 1.2°. (These come from the simplified equation for the radiation pattern of an antenna and its image, the latter being negative with respect to the object, $F = \sin(H \sin \theta)$. For maximum signal, $H \sin \theta = 90°, 270°$, etc. For minimum signal, $H \sin \theta = 180°, 360°$, etc. At 12 feet high, $12 \times 360° \sin \theta = 90°$, $\theta = 1.2°$ and $12 \times 360° (\sin \theta) = 180°$, $\theta = 2.4°$).

p. Figures 2-3a and 2-3b show the radiation conditions for the 12 foot and 6 foot heights respectively. The direct and reflected (image) signals are shown as parallel. For close-in distances, less than 10 to 100 times the height of the antenna, these signals are not quite parallel but they do act similarly to a parallel condition. At distances less than 10 times the height of the antenna, the above equations do not hold.

q. Bends in beacon courses are produced by so many variables that it is very difficult to specify with precision what the magnitude and location of course abberations may be. About the best that can be done is to describe siting conditions in generalities; and this can be done in many ways.

r. The following is one estimate of the size of metalic objects such as hangars that may cause bends. Consider first the energy magnitudes involved in a 1° bend. Figure 2-4 shows that the amplitude of the bend producing signal (reflected from a vertical object) is 0.018 units compared to 1 unit of desired signal. This means that the undesired signal is 20 log 1/0.018 = 35 db below the desired signal. From Figure 2-4, it is also seen that the phase of the signal is in quadrature with the desired signal. This imposes a condition in addition to amplitude which restricts the extent of the bend region.

Figure 2-4. One Degree Bend in Beacon Course

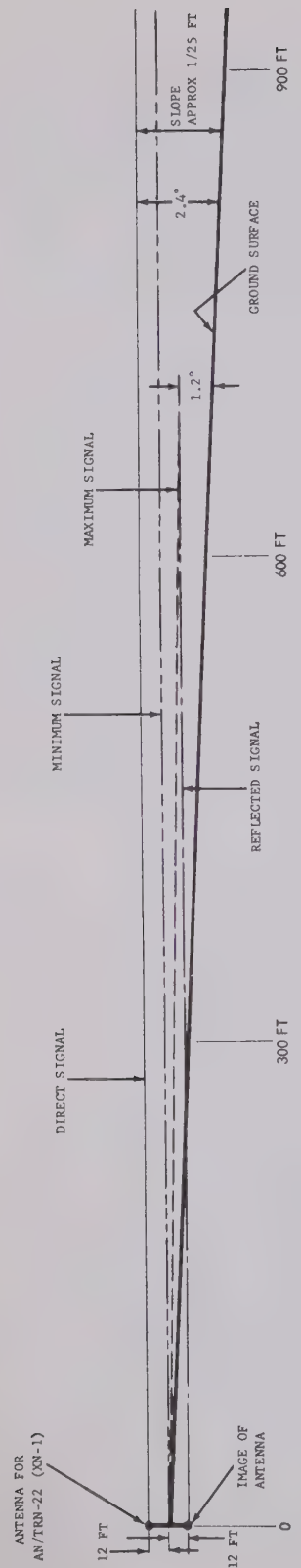


Figure 2-3a. Radiation Conditions for 12 ft Antenna Height

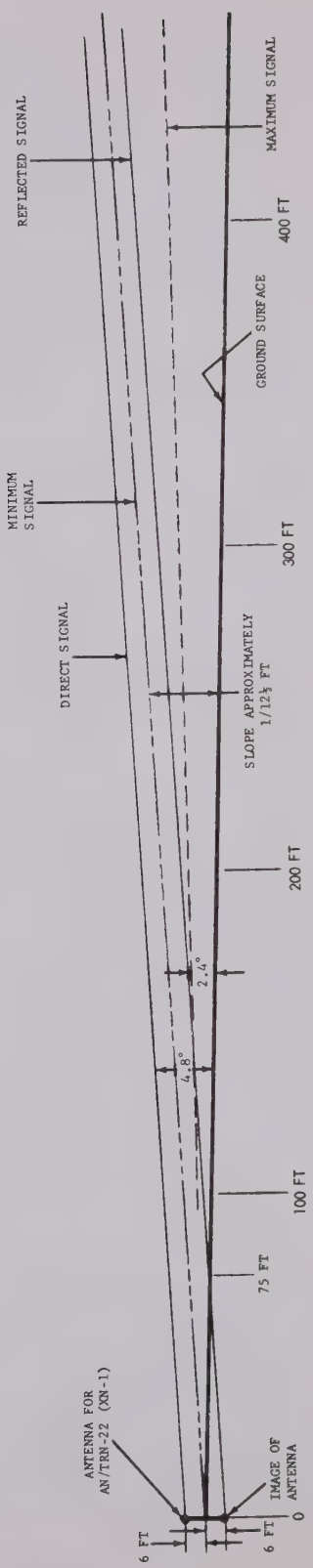


Figure 2-3b. Radiation Conditions for 6 ft Antenna Height

s. From handbooks it can be readily determined that at a distance of one mile, a 1000 MHz signal suffers 96 db loss. If a reflector at this distance had a gain of 96 db -35 db = 61 db, it would be capable of producing a 1° bend under the right phase conditions.

t. Again from handbooks, it can be found that a reflector having dimensions of about 480 ft on a side will have a gain close to 61 db at 1000 MHz. As pointed out above, the first lobe from a TACAN antenna at a 6 foot height above ground lies within a 1/12.5 ratio. For a distance of 1 mile, this corresponds to a height of 420 feet. In order for the reflecting object to have the 61 db gain at a 420 foot height, its length would have to be increased by 480/420 x 480 ft = 520 feet.

u. At one mile distant a length of 520 feet subtends an angle close to 6°. The 1/12.5 ratio is an angle of about 4½°. At 0.2 of a mile distant, 1056 feet, the above angles show that an object 84 feet high by 110 feet long may produce a 1° bend. An object half as high but twice as long would produce a similar result.

v. If the antenna is radiating over a ground surface such that nulls 10 db below lobe signals are produced, the unity ratio for the direct signal is decreased to 0.33. Therefore, in this region the bend amplitude goes up to 3½ degrees.

w. There is a further limitation on the above bend producing possibilities in that the effective height of the reflecting object will produce a number of vertical lobes which will increase the bend magnitudes in some regions and decrease them in other regions.

x. For an antenna height of 12 feet, an object which subtends a 2¼ degree vertical angle by a 12 degree horizontal angle will also cause 1° bends.

y. For different orientations of these reflecting objects, lengths will change in accord with the subtended angles.

2-4. INSTALLATION REQUIREMENTS.

Since site selection, antenna set-up and installing the transponder is accomplished by the operator. Instructions are given in Section 3 (Operation).

2-5. CABLE CONNECTIONS (Figures 2-5 and 2-6).

a. An r-f coaxial cable (W5) type r-f 225/U fitted with a type UG594A/U plug on each end, is to be attached to a coaxial connector A1J1 of the central array of the antenna and to a coaxial connector J2 on the back of the transponder.

b. An r-f coaxial cable (W6) type RG140/U fitted with a TNC plug at each end is to be connected on the antenna base to connector A1J1 and on the back of the transponder to connector J1. The cable brings the 15 Hz north reference trigger pulse to the transponder.

c. A power cable (W4) is to be connected from A1J3 on the antenna base to connector J3 on the back of the transponder. The cable provides the power for the antenna drive motor and the north reference trigger light source.

d. A power cable, W3 for battery use, W2 for alternate power supply use, or W7 if an external unregulated but filtered DC power supply is used, is to be connected from the DC source to connector J4 on the back of the transponder.

Caution

Only one end of the cable W7 is furnished with a connector that fits into connector J4 of the transponder. The other end must be connected to the proper polarity of the external DC source

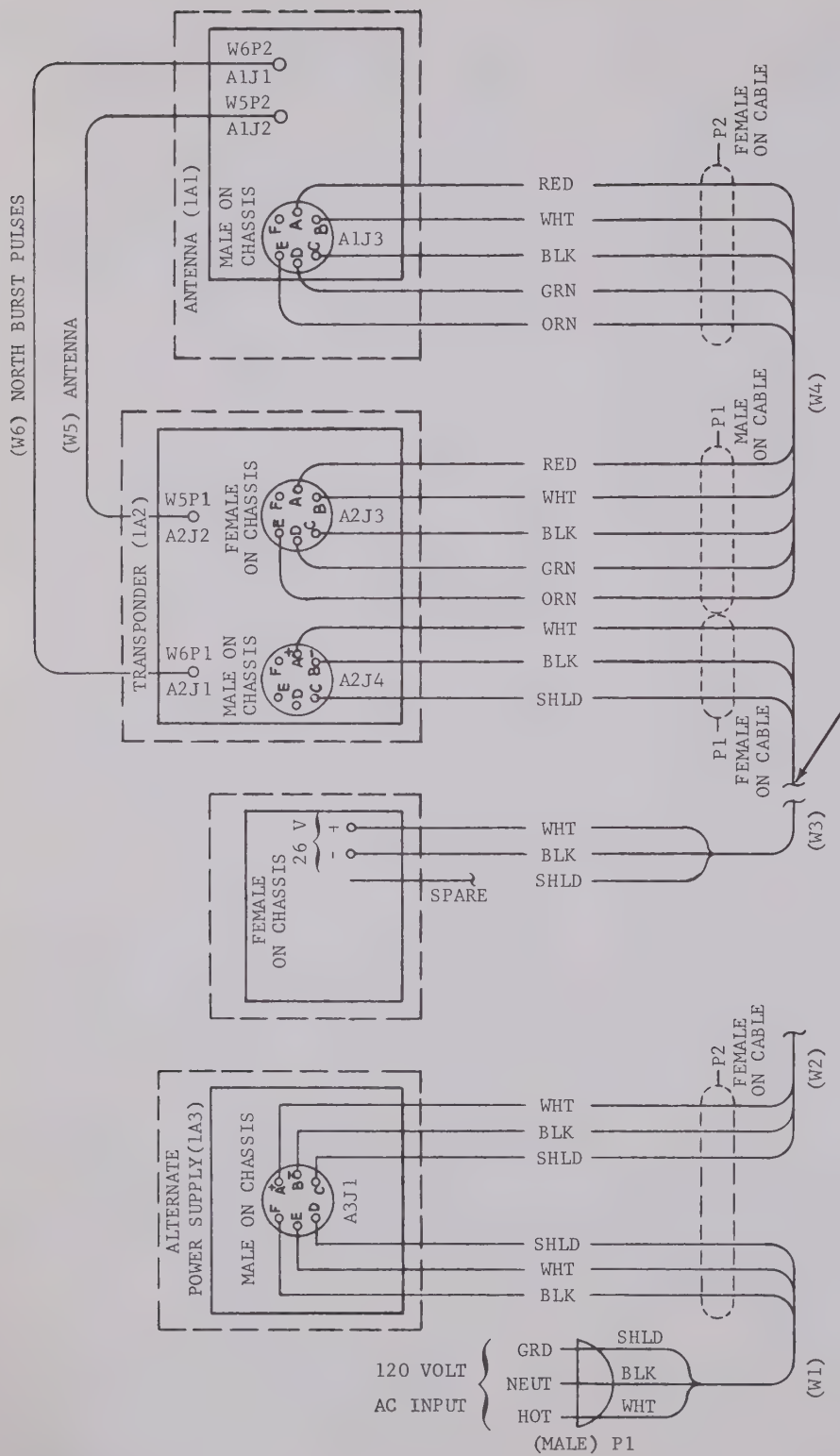


Figure 2-5. AN/TRN-22 (XN-1) Interconnecting Cabling Diagram

REFERENCE DESIGNATION	NO ACTIVE CONDUCTORS	COLOR	FROM	CONNECTOR	PIN NO	TO	CONNECTOR	PIN NO	FUNCTION	COND. AMP.	WIRE LENGTH	WIRE TYPE
W1	3	WHITE BLACK SHIELD	EXTERNAL POWER SOURCE	W1P1 UP121M	HOT NEUT GRD	ALTERNATE POWER SUPPLY	W1 & W2 P2 BENDIX MS 3116E-10-6S(SR)	E F D	120 VOLT A.C. POWER INPUT	.6A .6A 0	12'-0"	HI TEMP WIRE CO PART NO 2TX20-1930STJ
W2	3	WHITE + BLACK - SHIELD	ALTERNATE POWER SUPPLY	W1 & W2 P2 BENDIX MS 3116E-10-6S(SR)	A B C	TRANSPONDER	W2P1 BENDIX MS 3116E-10-6S (SR)	A B C D E F	+ -} 26 VOLTS DC GRD SPARE PIN SPARE PIN SPARE PIN	2A 2A 0 0 0	6'-6"	HI TEMP WIRE CO PART NO 2TX20-1930STJ
W3	3	WHITE + BLACK - SHIELD	BATTERY BB-451/U	W3P2 MONTEK D0024-62	+ - GRD	TRANSPONDER	W3P1 BENDIX MS 3116E-10-6S (SR)	A B C	+ -} 26 VOLTS DC GRD	2A 2A 0	2'-0"	HI TEMP WIRE CO PART NO 2TX20-1930STJ
W4	5	RED WHITE BLACK GREEN ORANGE BLUE WHT-BLK	TRANSPONDER	BENDIX MS 3116E-10-6P(SR) W4P1	A B C D E	ANTENNA DRIVE MOTOR & NORTH BURST LIGHT	W4P2 BENDIX MS 3116E-10-6S (SR) CONNON KPT08P10-6S	A B C D E F	+ -} 26 VOLTS DC + -} 12.6 VOLTS DC } SPARE PIN		7'-7"	NATIONAL WIRE NW-7263J
W5	1		TRANSPONDER	W5P1 UG21C/U		ANTENNA	W5P2 UG21C/U		ANTENNA r-f POWER		7'-7"	RG225/U
W6	1		ANTENNA PHOTO SENSOR	W6P2 MONTEK B001900		TRANSPONDER	W6P1 MONTEK B001355		NORTH BURST TRIGGER PULSE		7'-7"	RG141/U
W7	2	WHITE + BLACK - SHIELD	EXTERNAL POWER SOURCE	W7P1 BENDIX MS-3116E-10-65 (SR)	A+ B- C	TRANSPONDER	OPEN		22 TO 29 VOLT DC EXTERNAL PWR SUPPLY	2A	12'-0"	HI TEMP WIRE CO. PART NO 2TX20-1930STJ

Figure 2-6. AN/TRN-22 (XN-1) Running Sheet for Unit Interconnection

as marked on the cable. If a voltage with wrong polarity is applied to the transponder, the fuse will blow.

2-6. INSPECTION AND ADJUSTMENTS.

a. PROCEDURE FOR ENERGIZING THE EQUIPMENT FOR THE FIRST TIME.-

(1) The equipment is shipped with the crystal in place in the R-F OSCILLATOR. This crystal should not be replaced unless it is necessary to change the channel. If the channel frequency is changed, the transponder must be retuned in accordance with Paragraph 3-4d.

(2) Make sure that all panel screws are tight, so that interlocks will function properly.

(3) Set up and interconnect equipment as outlined in Paragraph 3-3b(5).

(4) Check to ensure that all connections have been properly made.

(5) Check the fuses and pilot lamp on alternate power supply to be sure they are properly installed.

(6) Inspect cables and panel-mounted components (particularly meter) to make sure that no damage has resulted during the transportation.

(7) Adhere to the operating procedures as described in Paragraph 3-4c.

b. PERFORMANCE CHECK.-

Performance check as outlined in Paragraph 3-7a, should be made to give reasonable assurance that the equipment is functioning normally.

2-7. INTERFERENCE REDUCTION.

a. See Paragraph 3-3a(2) for propagation and interference characterisitics.

b. If the receiver is jammed by a CW signal, or failure of the receiver occurs, the transponder set will continue to transmit 15-Hz bearing information. In this case, the transmitter is not triggered by pulses whose origin is receiver noise or interrogation of an aircraft, but instead the transmitter is triggered by random noise pulses generated from a separate source (ARRC) that is independent of receiver noise.

c. Keep all ferromagnetic material, such as guns, helmet, etc., a sufficient distance from the magnetic compass during alignment to avoid errors in the compass reading.

SECTION 3

OPERATION

3-1. GENERAL.

This section contains setup and operating instructions for Transponder Set AN/TRN-22 (XN-1) (radio beacon). Operating personnel should report any malfunctions of the equipment as soon as a malfunction is observed.

3-2. FUNCTIONAL OPERATION.

Transponder Set AN/TRN-22 (XN-1) transmits bearing and distance information which enables aircraft equiped with the standard TACAN airborne equipment (such as the AN/ARN-52 V) to determine their positions. Also, aircraft equipped with AN/ARN-21 equipment can obtain distance information from the AN/TRN-22 Transponder Set but cannot obtain bearing information because the transponder transmits only the 15-Hz modulation component of the TACAN signal. Interrogation signals, at a repetition rate peculiar to the AN/ARN-52 V or AN/ARN-21 are received by the AN/TRN-22 (XN-1) and these signals actuate the transmission of a series of replies at the same repetition rate. The replies are received by the interrogating aircraft, where comparison of the reply repetition rate with the repetition rate of the interrogating signal is made. The desired signal can be distinguished from reply signals actuated by other aircraft.

The interrogating aircraft obtains a distance measurement by measuring the total time elapsed between transmission of its initial interrogation signal and receipt in the aircraft of the corresponding ratio beacon reply pulse-pair.

Bearing information is transmitted by the radio beacon by modulating the antenna radiation pattern with a 15-Hz envelope and transmitting bursts of reference pulse-pair groups. The aircraft can determine its bearing by comparing the phase of the reconstructed 15-Hz antenna modulation envelope with the time occurrence of the reference bursts. (Refer to sections 1 and 4 for a detailed explanation of radio beacon operation.)

a. RADIO BEACON SIGNALS.-

(1) The radio beacon transmits on one of 126 1-MHz channels in the ranges of 962 to 1024 MHz and 1151 to 1213 MHz, and receives on one of 126 1-MHz channels in the range of 1025 to 1150 MHz. Assuming 95% of the interrogating aircraft are in track and 5% are in search, distance measuring service can be provided to as many as 50 interrogating aircraft.

(2) The radio beacon transmits 1530 pulse-pairs, of which 1350 are distance interrogation replies and/or random noise pulses. The other 180 pulses are reference burst pulses that provide bearing information.

(3) Peak power emitted from the radio beacon is 100 watts minimum. The maximum range of the beacon is 40 nautical miles for distance and bearing information.

b. ANTENNA.-

(1) The antenna used with the transponder is a 15-Hz, single lobe antenna and consists of a stationary central array, a rotating parasitic reflector element, an antenna drive motor, and a protective radome. The antenna is mounted on a tripod and can be adjusted to a maximum height of 12 ft above ground.

(2) The antenna receives distance interrogation signals from the

airborne equipment and radiates distance reply signals. The antenna also radiates bearing and north burst reference signals. The rotating reflector element revolves at 900 rpm in order to modulate the transmitted signal at 15-Hz.

(3) The antenna for the AN/TRN-22 (XN-1) is designed for transmission and reception of signal in the low band only.

c. TRANSPONDER.-

(1) GENERAL.- The transponder consists of the receiver, level detector, decoder, automatic repetition rate control circuit, encoder/modulator, r-f oscillator, transmitter frequency multiplier chain, L-O frequency multiplier chain, r-f power amplifier and power supply.

(2) RECEIVER.- This unit performs the following functions:

(a) Receives from the antenna the interrogation pulse-pairs transmitted by the aircraft;

(b) Converts the received distance interrogation L-band signals, along with random noise pulses generated within the mixer and the i-f amplifier into an intermediate frequency of 63 MHz, and amplifies and demodulates these signals; and

(c) Maintains (by controlling i-f amplifier gain) a constant output at 1350 ±135 pulses per second of the decoder, regardless of the interrogation rate.

(3) LEVEL DETECTOR.- The logarithmic i-f amplifier compresses the r-f input pulse. Since timing is based on the 50% pulse amplitude of the leading edge of the original Gaussian pulse, the 6 db or 50% pulse amplitude always occurs at a fixed voltage difference from the peak of the video pulse.

(4) DECODER.- The decoder produces a single pulse for each input pulse-pair received from the level detector having pulses separated by 12 microseconds. It is important that the transponder responds to a single interrogation pulse-pair with one and only one reply pulse-pair. Multiple replies to a single interrogation can result in serious distance measurement errors. This problem is dominant in mountainous areas as a greater percentage of properly coded interrogation signals can arrive via indirect routes due to the presence of more reflecting surfaces.

(5) AUTOMATIC REP-RATE CONTROL (ARRC).- When the AN/TRN-22 (XN-1) receiver is jammed by a CW signal, squitter pulses are no longer generated in the receiver. But, it is very vital that the transponder set continues to transmit the 15-Hz bearing information. In this case the ARRC circuit automatically takes over the generation of the squitter pulses. An internal feedback loop maintains the squitter pulse rate constant at 1350 ±135 pulses per second. An inhibit gate is incorporated into the ARRC circuit. It is actuated by the dead time gate generated in the control circuit. The purpose of the dead time gate is to prevent acceptance of any interrogation or noise pulses for a period equal to that of the dead time of 20 to 65 microseconds (normally adjusted to 60 microseconds) after a pulse has entered the control circuit. This allows sufficient recovery time in the units constituting the transmitter.

(6) CONTROL CIRCUIT.- The control circuit performs the following functions:

(a) Generates a 15-Hz north reference burst each time a 15-Hz trigger pulse is generated in the antenna;

(b) Processes both the decoded distance interrogation pulses and the squitter pulses, and, in

combination with time delays in the receiver, decoder and transmitter, adjusts their net transit time through the beacon to 50 ±0.25 microseconds;

(c) Assigns priority of transmission to the north reference burst signal over interrogation and squitter pulses;

(d) Generates receiver dead time gate; and

(e) Provides north reference burst pre-gating, thus preventing occasional receiver signals from occurring within 51 microseconds of the transmission of the first pulse of the 15-Hz north reference burst.

(7) ENCODER AND MODULATOR.- The encoder circuit receives trigger pulses from the control circuit and encodes and identifies them as TACAN radio beacon signals. Each pulse is converted into an approximately Gaussian shaped pulse-pair and superimposed on a pulse-pair pedestal. The modulator section receives the properly shaped pulse-pairs and provides the power necessary to modulate the r-f power amplifier.

(8) R-F OSCILLATOR.- The r-f oscillator is a crystal controlled oscillator tunable over a wide frequency band. The module contains oscillator and amplifier stages. The oscillator may be tuned on any of 126 crystal frequencies by installing the desired crystal and tuning by means of a front panel screwdriver adjustment for a maximum front panel test meter reading.

(9) TRANSMITTER FREQUENCY MULTIPLIER CHAIN.- The crystal oscillator generates a signal in the range from 40.083333 to 43.321429 MHz. The oscillator frequency is multiplied by two doublers and a harmonic generator in the multiplier chain. The output signal of the harmonic generator is coupled into a resonant cavity that is tuned to the 6th harmonic of the incoming signal (the 24th harmonic of the oscillator frequency) for low band operation (962 to 1024 MHz) or tuned to the 7th harmonic of the incoming signal (the 28th harmonic of the oscillator frequency) for high band operation (1151 to 1213 MHz). The final amplifier stage of the chain is gated on during transmission. This gating reduces the DC power consumption. The output signal of the transmitter frequency multiplier chain is applied to the r-f power amplifier.

(10) LOCAL OSCILLATOR FREQUENCY MULTIPLIER CHAIN.- A portion of the signal is tapped off the second r-f amplifier stage of the transmitter multiplier chain and multiplied through a second modified frequency multiplier chain for use as the transponder receiver local oscillator signal. Frequency tuning is accomplished from the transponder front panel.

(11) R-F POWER AMPLIFIER.- The r-f power amplifier consists of three cascaded L-band tube/cavity amplifiers: preamplifiers V_1 and V_2 and final amplifier V_3. All three tubes operate in grounded grid mode. The r-f input signal is coupled to the cathode of tube V_1. Pulse-pair modulation of the r-f signal is accomplished by applying the video signal from the modulator to the cathode of the first and second tube. The final tube, V_3, is biased cut-off and operates in class-C mode.

(12) POWER SUPPLY.- The power supply in the transponder consists of two main parts--the voltage regulator and the DC to DC converter.

(a) The voltage regulator circuit provides a constant voltage source independent of variation of the input voltage and variation of the load resistance.

(b) The purpose of the DC to DC converter is to efficiently convert the DC output of the voltage

regulator to DC voltages of different levels. The load of the converter is practically constant; hence, for constant (regulated) input voltage the output voltage is also constant.

d. BATTERY.-

The transponder set including the antenna drive operates from a silver-zinc 24 V (nominal) BB-451/U type rechargeable storage battery capable of operating the beacon for about 12 hours. This battery is clamped directly to the bottom of the transponder.

e. ALTERNATE POWER SUPPLY.-

The alternate power supply can be used in lieu of a battery. It provides an unregulated, but filtered, DC output of 25 V nominal. This power supply can operate from a power source of 50 Hz to 450 Hz and 120 V ±10 percent single phase. It is attached to the transponder in the same manner as the battery. A DC adapter cable can be used to connect power between an external unregulated DC source and the transponder set. The cable is provided with connectors that mate with the power input connector of the transponder.

3-3.- PREPARATION FOR USE.

a. SITE SELECTION.-

(1) GENERAL.- Although the transponder set is designed to be used on an unimproved site on almost any type of terrain, the following criteria should be considered in order to select the best possible site:

(a) Which allows adequate propagation of signals and provides a minimum of interference characteristics; and

(b) Which has availability of geographic references to facilitate orientation of the antenna.

(2) PROPAGATION AND INTERFERENCE.- The radio set radiation pattern as seen at the aircraft, is not an ideal, free space pattern. Reflections from the surface of the earth and from vertical surfaces, in the vicinity of the radio set, will alter the radiation pattern. Reflections from the earth's surface will result in partial cancellation of the direct signal in certain areas, thus reducing the maximum range in those areas. The smoother the surface, the greater will be the reflections. Reflections from vertical surfaces cause shadows of reduced signal strength and in addition, the reflected signal may cause bearing or distance errors in other directions. To minimize reflections, the transponder set site must be carefully chosen. The choice of sites available depends, somewhat, on the intended use of the transponder set. Typical uses of the transponder set are as a tactical enroute navigational aid, and as a tactical penetration and approach aid. Specific recommendations for each type of use follow.

(a) TACTICAL ENROUTE NAVIGATION AID.-

1) In hilly, heavily wooded terrain, locate the transponder set on the highest available site to avoid shadows in the coverage area.

2) In flat wooded terrain, locate the radio set on high ground with the antenna just above tree level.

3) In flat or rolling terrain with moderate ground cover, the most desirable sites are those around which the heaviest ground cover extends in all directions. To be most effective, ground cover should be at least four feet tall over most of the area with taller brush or trees interspersed. Locate the transponder set so that a minimum of level uncovered ground can be viewed from the antenna out to a distance of one mile. To approach this

condition, it may be necessary to position the radio set as low as possible, consistent with the range requirements and the desire to avoid illumination of nearby objects.

(b) TACTICAL PENETRATION AND APPROACH AID.-

1) The radio set should be as low as possible (See Paragraph 3-3, a, (2).

2) Make full use of available ground cover (See Paragraph 3-3, a, (2), (a).

3) If guidance on the later stages of approach is desired, consider locating the transponder set on the back end of the runway.

4) Locate the transponder set as far as possible from other structures and from areas where the location or movement of vehicles could disrupt the radiation pattern. If large buildings are present, the location must be such that "mirror" reflections do not occur along the approach paths.

b. SETUP INSTRUCTIONS.-

The complete transponder set, AN/TRN-22 (XN-1), in transport condition consists of three separate packages:

(1) GENERAL.-

(a) The rotating antenna assembly and the tripod assembly, with cables that are contained in a carrying bag,

(b) The transponder assembly with battery attached,

(c) The self-contained alternate power supply assembly for operational use in lieu of the battery when AC power is available. To place the AN/TRN-22 (XN-1) in operational condition the following outlined steps are required.

(2) TRIPOD SETUP.-

(a) Pick up carrying case which contains the tripod assembly and the rotating antenna assembly. Place it on the ground in vertical position with base down (zipper end up) zip open top of bag exposing the radome. Holding the exposed radome pull bag down until the tripod assembly can be freely removed from the carrying case. (See Figure 3-1.)

(b) Lay complete assembly in horizontal position on ground and extend tripod legs to desired operational height. This is accomplished by loosening the top knurled locknut. (See Figure 3-2.)

Caution

All knurled locknuts have right hand threads. Turn clockwise to loosen and counterclockwise to tighten.

Extend the first section of each three legs until each leg is seated against the built-in mechanical stops. This is recommended as the minimum operational height.

(c) Following is a tabulated list giving the exact heights when each section is fully extended from the ground level to the top of radome:

1) With the first section fully extended--7 ft 1 in;

2) With the second section fully extended--9 ft 4 in; and

3) With the third section fully extended--11 ft 8 in.

(d) Any increment

Figure 3-1. Removing Antenna and Tripod from Carrying Case

Figure 3-2. Extending the Tripod Legs to Proper Height

between these heights may be set simply by partially extending any leg between the built-in mechanical stops and securely locking the knurled locknuts in place.

Note

If an intermediate position is desired, make sure all three legs are extended to approximately the same length.

(e) Although it is neither desirous, nor recommended that the antenna be operated above 10 feet because of that so called "Brewster Effect", provisions have been made on the tripod to extend the transponder assembly down to the eye level if operated above 9 ft, 6 in. This is accomplished by loosening the large knurled locknut, located on the center extension shaft (See Figure 3-3) and sliding out the inner extension tube to an additional length of two feet.

1) Unbuckle strap that secures the three legs to the spacer yoke. (See Figure 3-2.)

2) Swing tripod into upright position and spread open each leg until it rests against the stop pins located on the tripod mounting pedestal. Figure 3-3 shows tripod set up in proper position.

3) With tripod in upright position, align center mounting tube to an approximate vertical position and lock in place using the monoball locking knob located on the tripod mounting base, or if out of reach, because of extended height; the monoball locking knob located at the end of the locking extension shaft. (See Figure 3-3 and Figure 3-4.) This will secure the center extension tube while mounting the transponder assembly.

(3) MOUNTING TRANSPONDER ASSEMBLY.-

Note

Although transponder assembly and battery are mounted together during transit, it is recommended at this point to disconnect the battery from the transponder and mount each one separately as will be outlined. This reduces the handling weight by 16 lb (weight of battery) which is expecially helpful if only one man is doing the setup.

(a) Unscrew the locknut on the transponder mounting clamp located directly below the compass until there is approximately ¼ in. clearance between the compass yoke and the mounting clamp.

(b) Slide transponder assembly over clamp through slotted bracket located on top of the transponder. Note the white painted line located on this bracket. Also note a corresponding white line located on the base of the compass mounting yoke. Before securing transponder in place, rotate transponder assembly until these two lines match up. This is a predetermined position to assure that the compass needle will actually be pointing to magnetic north after the setup has been completed. In this marked position, any ferro-magnetic materials located in the transponder assembly will cause no compass deviation.

(c) With transponder and mounting yoke oriented into this position, tighten down locknut until unit is firmly secured to the tripod. (See Figure 3-5.)

Note

Six holes are located around the locknut O.D. for inserting a 3/16 dia rod. This tool is used to securely tighten the transponder assembly to the tripod. Although a phillips head screwdriver will do, a tool of this

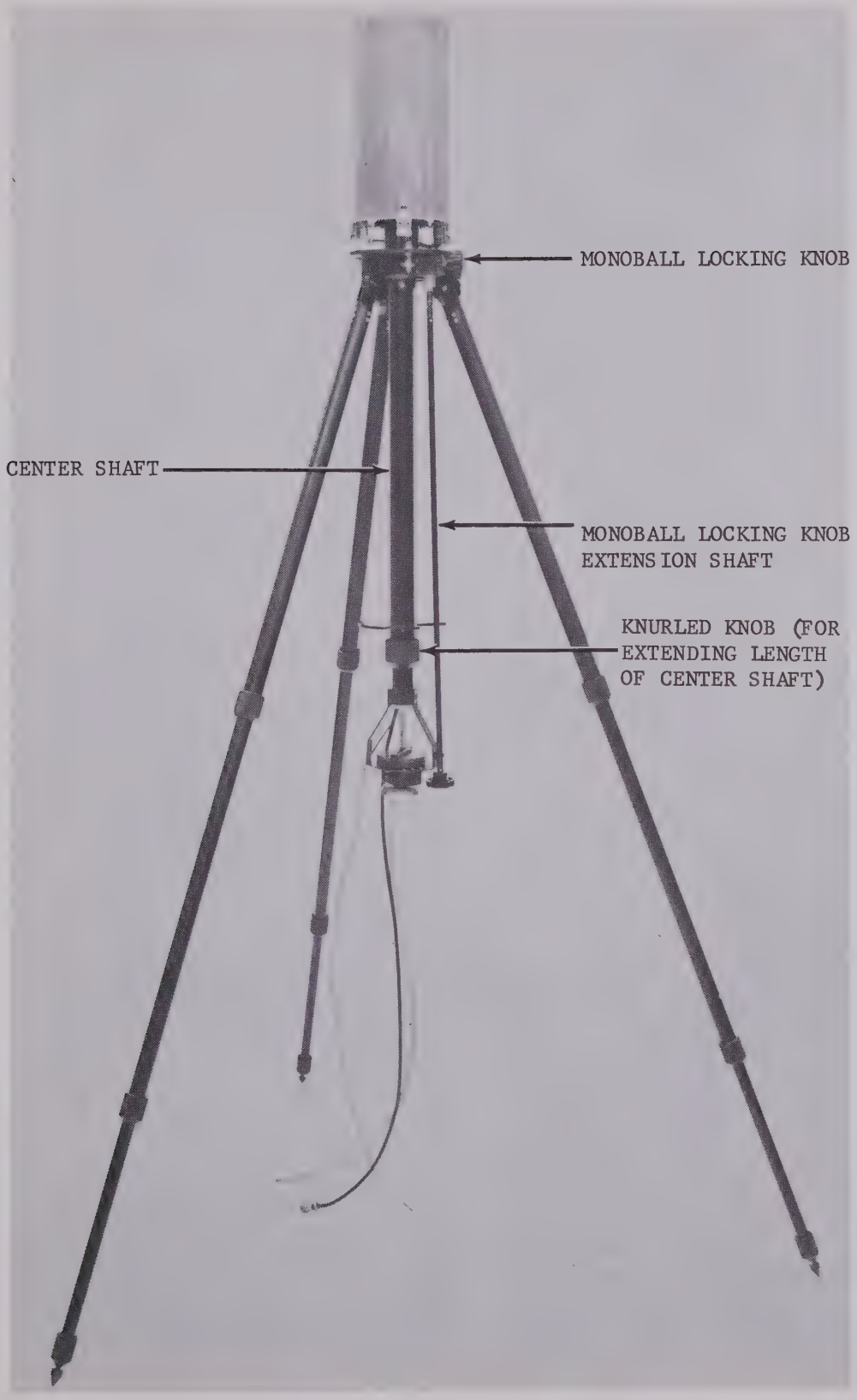


Figure 3-3. Antenna, Tripod, and Cabling Setup--Prior to attachment of Transponder and Battery

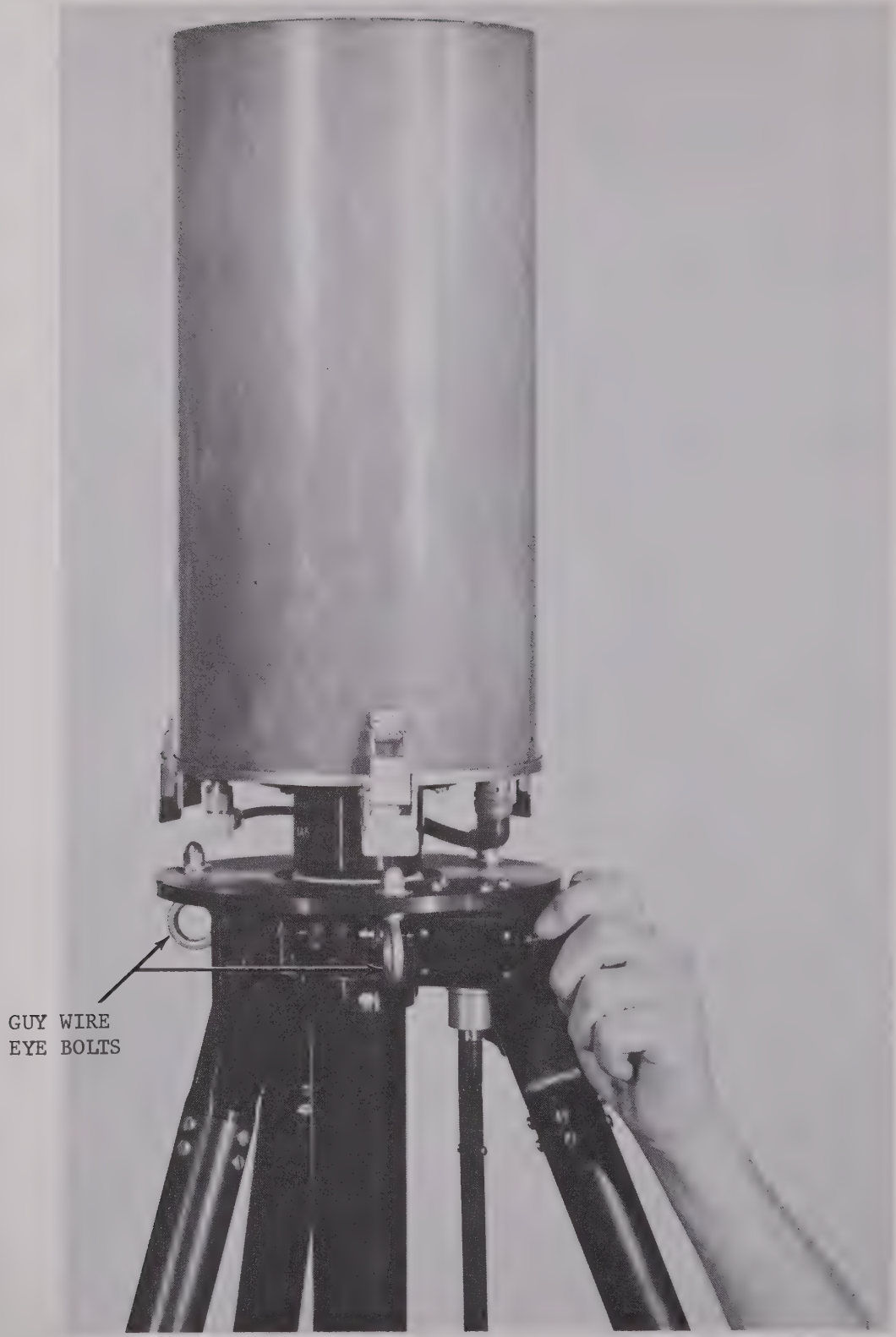


Figure 3-4. Tightening the Monoball Locking Knob. (This Knob Locks the Center Mounting Tube in Position After the Legs are Extended.)

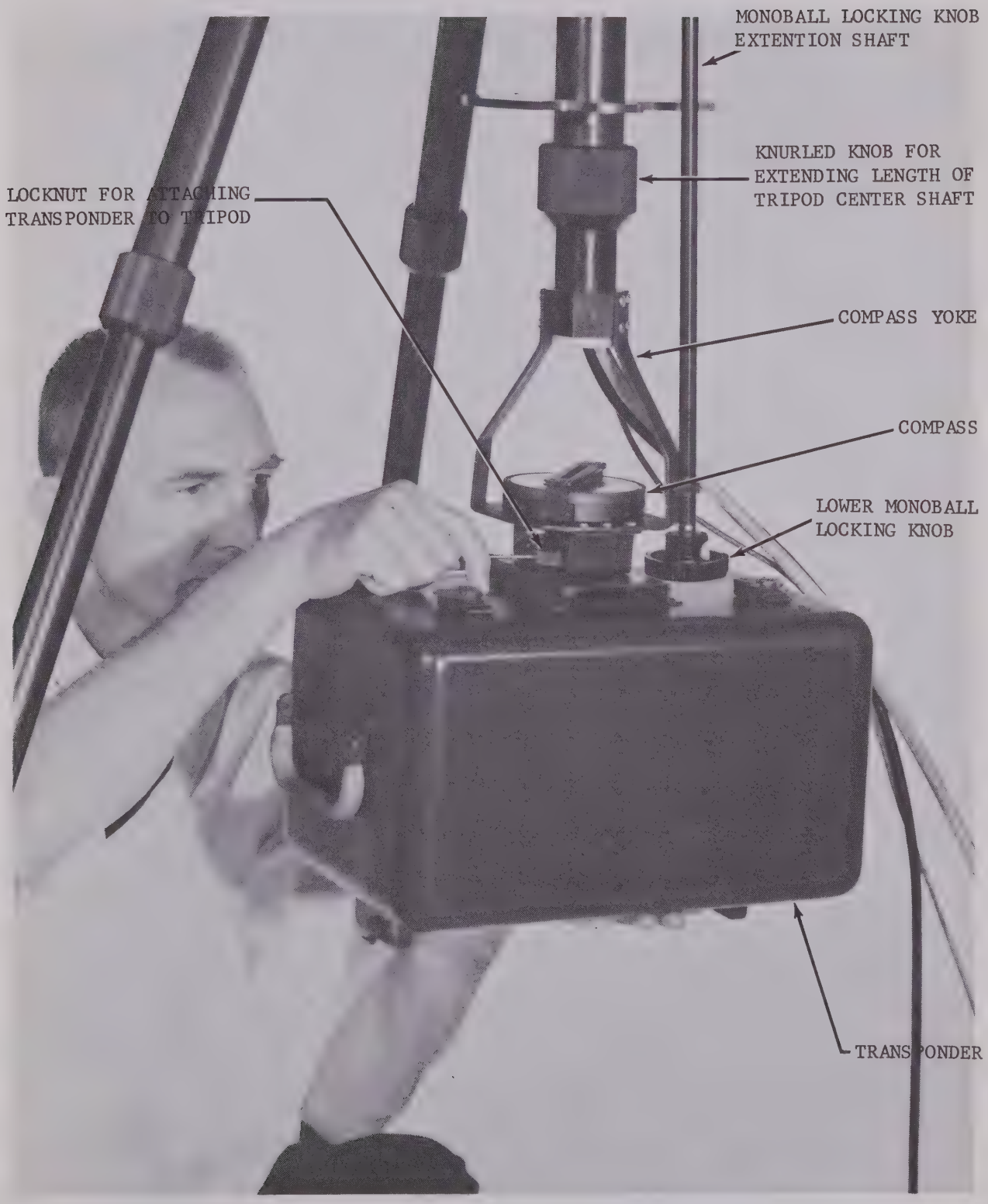


Figure 3-5. Attaching Transponder to Tripod

type will be supplied and is located in the accessory pocket of the carrying bag.

Figure 3-6 shows transponder assembly properly mounted.

(4) MOUNTING BATTERY.-

Pick up battery (1A4) and make sure both throw catches are in the open position. Place one throw catch on hook located on the bottom of the transponder assembly. Swing battery up into position and hook the other throw catch in place. After centering the battery on the mounting blocks, snap each throw catch down. (See Figure 3-7) This secures the battery to the transponder assembly. Figure 3-8 shows tripod assembly, transponder assembly, and battery assembly properly mounted.

(5) CABLE CONNECTIONS TO TRANSPONDER ASSEMBLY 1A2.-

(a) Connect cable assembly marked "W6P1" to TNC jack marked "(A2) J1". This connects the north reference pulse generator from the antenna assembly.

(b) Connect cable assembly marked "W5P1" to "N" jack marked "(A2) J2". This connects the central array antenna from the antenna assembly.

(c) Connect cable assembly marked "W4P1" to 6-pin connector marked "(A2) J3". This connects the antenna drive motor and the north reference trigger lamp from the antenna assembly to the transponder assembly.

(d) Connect cable assembly marked "W3P1" to the 6-pin connector marked "(A2) J4". This connects the battery to the transponder assembly.

Note

Identical connectors "J3" and "J4" are keyed to prevent improper connecting.

Figure 3-9 shows transponder assembly with proper cable connections.

(6) CABLE CONNECTIONS TO ANTENNA ASSEMBLY 1A1.-

Note

Although the cable hookup for the antenna assembly will be connected prior to field use, the following paragraphs outline the proper cable connections.

(a) Connect cable assembly marked "W5P2", type "N" connector to connector marked "(A1) J2" on the antenna assembly. This connects the central array antenna to the transponder. To accomplish this, the six bolts located on the antenna assembly to the tripod assembly, must be removed.

1) Remove radome by releasing the three throw catches.

2) Remove the six screws holding the antenna assembly to the tripod mounting pedestal.

3) Lift off antenna assembly from the tripod exposing the type "N" connector located in the center of the base plate and marked "(A1) J2".

4) Feed cable up center mounting shaft, make connection and remount in place using the six screws.

Caution

Remount antenna assembly to the tripod mounting pedestal in exactly the same position in which it was removed by lining up the two match lines painted on the antenna base plate and the tripod mounting pedestal; otherwise the orientation between the north burst and magnetic north of the compass will be in error.

(b) Connect cable

Figure 3-6. Transponder Assembly Mounted to Tripod Center Post

Figure 3-7. Attaching Battery to Bottom of Transponder

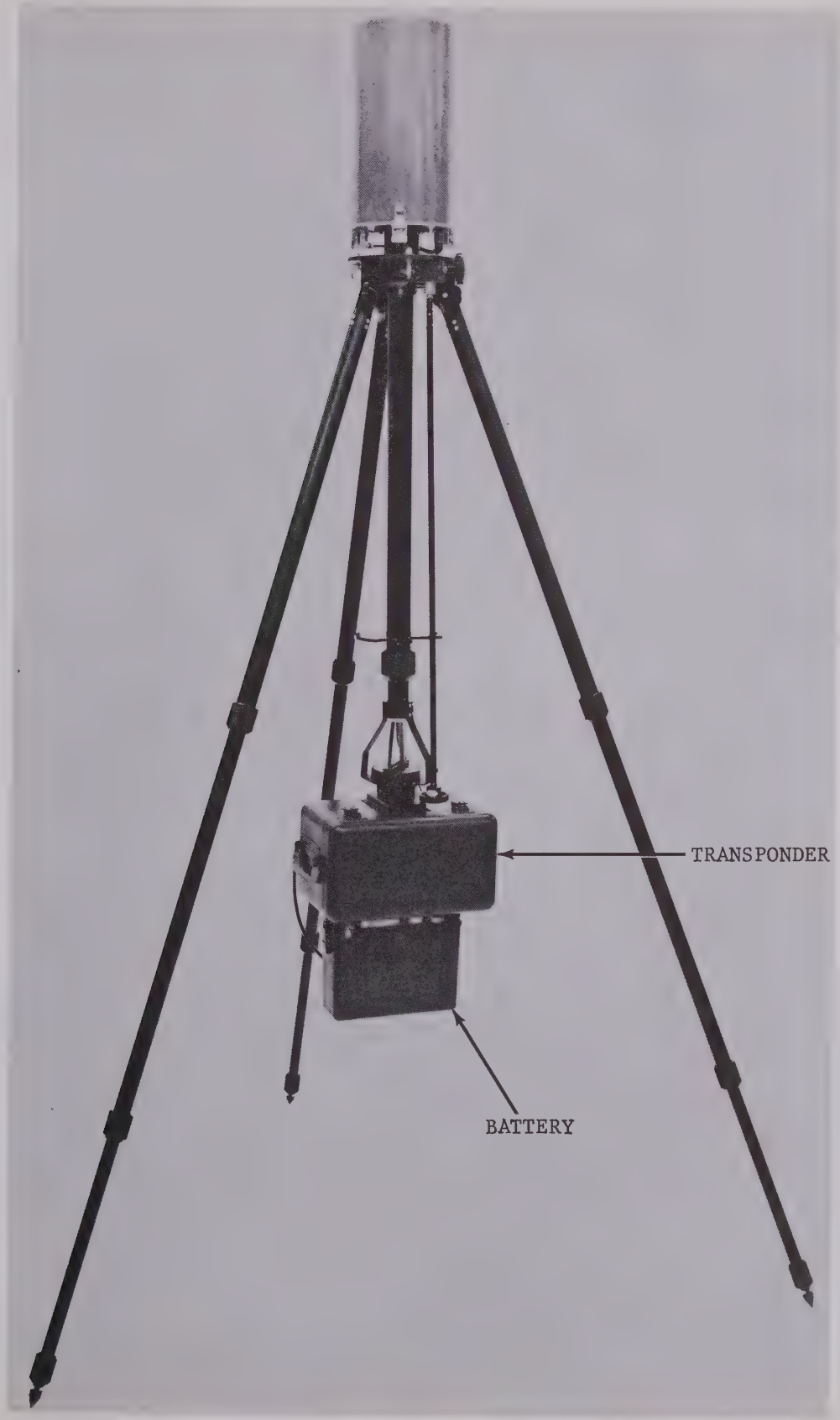


Figure 3-8. Transponder and Battery Attached to Tripod Center Post

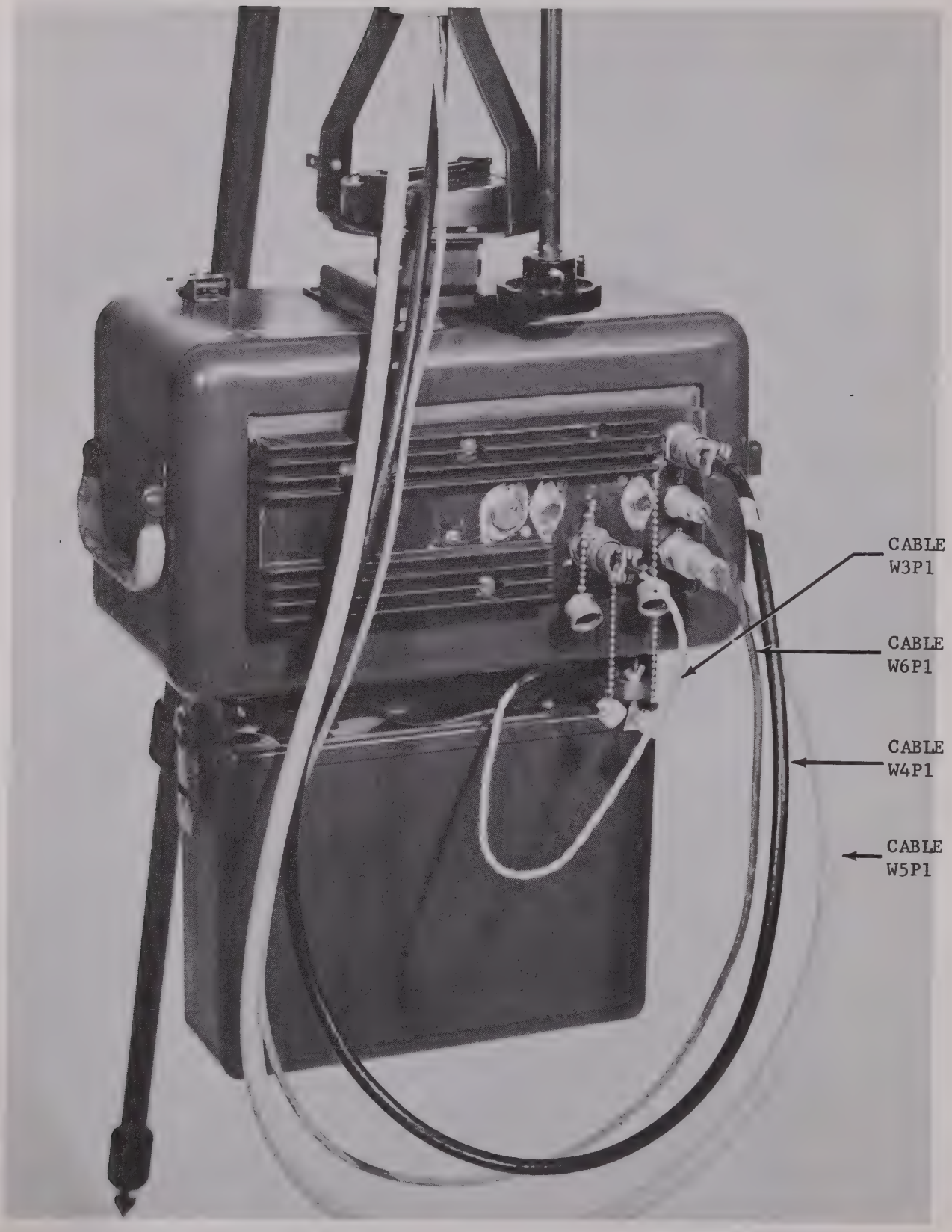


Figure 3-9. Transponder and Battery Assembly with Proper Cable Connections

assembly marked "W6P2" to type TNC connector marked "(A1) J1". This connects the north burst pulses to the transponder assembly.

(c) Connect cable assembly marked "W4P2" (right angle connector) to 6-pin connector marked "(A1) J3". This connects the antenna drive motor and the north burst lamp to the transponder assembly.

(7) ORIENTATION OF ANTENNA TO MAGNETIC NORTH.-

(a) Release compass needle lock on induction damped compass to allow needle to swing freely. This lock is located beneath the compass mounting yoke. (See Figure 3-13) Turn knurled lock clockwise until needle rests freely on compass needle pivot.

(b) Release monoball lock (See Figure 3-3 or Figure 3-4) to allow antenna and transponder assembly to move freely.

(c) After needle has become stable (maximum time 25 seconds) rotate center extension shaft until north end of compass needle lines up with zero degree reading on compass rose. (North end of needle is painted with white luminous paint.) This zero degree mark is mechanically positioned in exactly the same vertical plane as the north burst pick-off bracket located on the antenna assembly.

Note

Fine adjustments or compensation may be made on the north burst pick-off bracket located on the antenna assembly (See Figure 5-5) by loosening the mounting screws and sliding bracket in the slotted holes in the direction required. The final adjustment of this bracket should be made during actual flight check and should never be moved once its final position has been determined.

(d) As the antenna is rotated into position and the north end of the compass needle is lined up with the zero degree reading on the compass rose, simultaneously move the transponder assembly until its level position is indicated by the level bubble located on the compass face. After both conditions have been satisfied, that is, compass needle is in proper position and bubble indicates that the unit is level, securely lock in place using either the lower extension shaft locking knob or the upper locking knob. (See Figure 3-4 and Figure 3-10)

(e) The unit is now ready for operation. Figure 3-11 shows the unit in operating condition with battery attached. For transponder operation see Section 3-4.

Note

Periodically re-check needle and bubble alignment--especially if excessive adjustments have been performed on the transponder and/or if tripod has been accidentally bumped.

Caution

Keep all ferro-magnetic material, as for example guns, helmet, etc., a sufficient distance from the magnetic compass during alignment in order to avoid errors in the compass reading.

(8) ATTACHING ALTERNATE POWER SUPPLY FOR AC POWER OPERATION.-

(a) Disconnect battery cable from transponder, that is, remove cable assembly marked "W3P1" from the connector marked "J4" on the transponder assembly. (See Figure 3-9)

(b) Remove battery by

Figure 3-10. Adjusting the Compass. (Note That the Operator Is Ready to Lock the Center Shaft in Position by Turning the Monoball Locking Knob in His Left Hand.)

Figure 3-11. Transponder Unit in Operating Condition with Battery Attached

un-snapping the two throw catch latches.

(c) Remove cover from alternate power supply and lift up into place re-snapping the two throw catch latches securely on the hooks of the transponder battery mounting blocks. (See Figure 3-12.)

(d) Figure 3-13 shows the alternate power supply mounted to the transponder assembly ready for operation.

Note

The same setup and alignment procedures as outlined are applicable for both battery or alternate power supply operation.

(9) TRIPOD TIE DOWN.-

Under severe wind conditions it is recommended that the tripod assembly be secured down with guy wires. Although guy wires are not furnished with the equipment, provisions have been made to complete this requirement. Three eye bolts have been mounted on the tripod base place (See Figure 3-4) for the guy wire hookup.

3-4. OPERATING PROCEDURES.-

a. DESCRIPTION OF CONTROLS.-

The radio beacon is placed into operation by controls located on the front panel of the transponder. (See Figure 3-14 and Table 3-1.) When the alternate power supply (See Figure 3-13) is used in place of the battery BB-451/U the on-off switch on the front panel of the alternate power supply must also be turned on. The test meter located on the front panel of the transponder gives information for tuning and maintenance purposes, but the operator needs only to use the meter to determine that the battery voltage is within the acceptable limits for normal operation of the equipment. Controls for tuning the beacon to other channel frequencies are also on the front panel of the transponder, but they do not need any adjustment during normal operation. The MODE SW can be placed into standby (stby) position. This removes the 25.2 VDC supply from the final stage of the XMTR MULT CHAIN and biases the r-f power amplifier tubes into cut-off.

b. DISTANCE MEASURING ONLY.-

The transponder can be used to transmit only distance measuring information if so desired. This is accomplished by positioning all switches for normal operation as instructed in paragraph 3-4, c (2), except DO NOT turn the PRIMARY POWER ANT switch to ON. This keeps the antenna drive motor de-energized, thus no 15-Hz bearing information modulation is superimposed on the radiation pattern. In this condition the transponder will continue to reply to interrogations thus supplying distance information but not bearing information.

c. SEQUENCE OF OPERATION.-

(1) PRELIMINARY CONTROL SETTINGS FOR INITIAL STARTING.-

To start the equipment, set the controls to the position given in Table 3-2, then proceed according to the step-by-step instructions given in paragraph (2) below.

Warning

The antenna or a 50 Ω dummy load should always be connected to the transponder antenna connector J2.

Never energize the transponder when the transmitter output J2 is unloaded.

(2) STARTING PROCEDURE FOR NORMAL OPERATION.-

(a) Step 1.- Check to see if the RCVR PRESELECTOR has been tuned to the receiver frequency for the selected channel (See Sample Tuning

Figure 3-12. Mounting the Alternate Power Supply

Figure 3-13. Alternate Power Supply Mounted to Bottom of Transponder

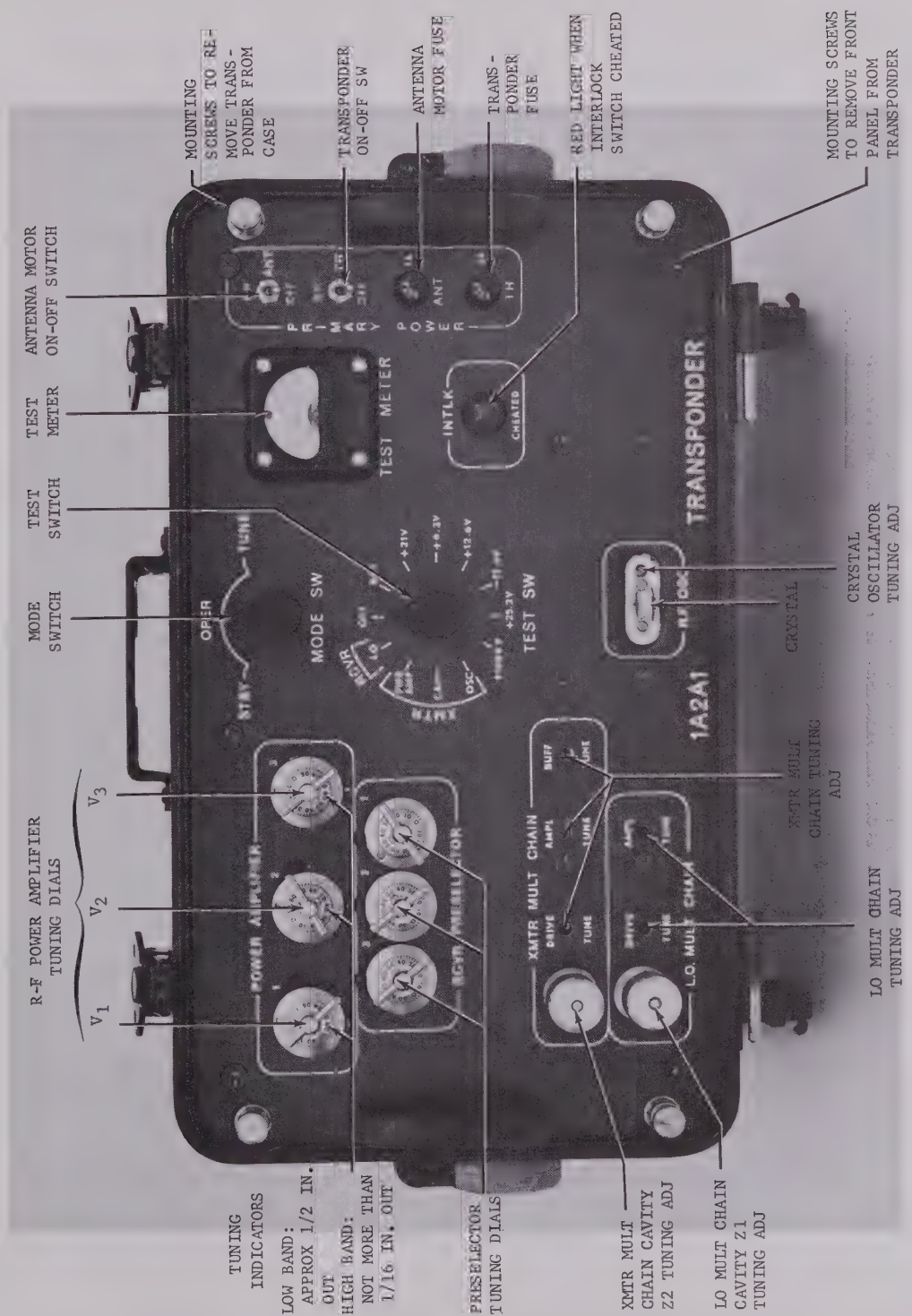


Figure 3-14. Transponder Front Panel Controls

TABLE 3-1. OPERATING CONTROLS

CONTROL	POSITION	FUNCTION
		TRANSPONDER
PRIMARY POWER ANT (Switch Toggle)	ON	Applies power to the antenna drive motor.
	OFF	De-energizes antenna drive motor.
PRIMARY POWER TR (Switch Toggle)	ON	Applies power to the transponder and the light source and photo sensor inside the antenna radome.
	OFF	De-energizes transponder, light source and photo sensor.
TEST SW (12 Positions) (Selects readings indicated on test meter)	OFF	-
	BAT	Battery voltage or alternate power supply voltage.
	21 V	Regulated voltage of the power supply regulator.
	6.3 V	R-F power amplifier tube filament voltage.
	12.6 V	12.6 VDC power supply voltage.
	-12.6 V	-12.6 VDC power supply voltage.
	25.2 V	25.2 VDC power supply voltage.
	1000 V	1000 VDC plate voltage of the r-f power amplifier.
	OSC	Indication for peak tuning of crystal controlled oscillator.
	CAV	Indication for peak tuning of XMTR MULTI CHAIN if MODE SW is in TUNE position.
	PWR AMPL	Indication for peak tuning of R-F PWR AMPL.
	LO	Indication for peak tuning of LO MULTI CHAIN.
MODE SW (3 positions)	STBY	Removes 25.2 V from transmitter multiplier chain and biases r-f power amplifier tubes into cut-off.

TABLE 3-1. (Cont)

CONTROL	POSITION	FUNCTION
		TRANSPONDER
MODE SW (Cont)	OPERATE	All sections of transponder are energized and operational.
	TUNE	25.2 V are applied continuously to the transmitter multiplier chain, causing it to operate in a CW mode for tuning and r-f power amplifiers are biased into cut-off.
RCVR PRE SEL		Primary power TR "OFF"
(3 TUN ADJ):		Use tuning chart, Figure 3-15A and B
1		Tuning for first section of receiver preselector.
2		Tuning for second section of receiver preselector.
3		Tuning for third section of receiver preselector.
POWER AMPL		Primary power TR "OFF"
(3 TUN ADJ):		Use tuning chart Figure 3-15A and B Test SW in PWR AMPL position
1		Tuning for first r-f power amplifier. } Tuned
2		Tuning for second r-f power amplifier. } for
3		Tuning for third r-f power amplifier. } peak
XMTR MULT CHAIN:		MODE SW in TUNE position TEST SW in CAV position
BUFF TUNE		Buffer AMPL tuned for peak.
AMPL TUNE		Final AMPL tuned for peak.
DRIVE TUNE		Harmonic generator drive tuned for peak.
22		Cavity tuned for peak.
RCVR MULT CHAIN:		TEST SW in OSC position
AMPL TUNE		Amplifier tuned for peak.
DRIVE TUNE		Harmonic generator drive tune for peak.
21		Cavity tuned for peak.

TABLE 3-1. (Cont)

CONTROL	POSITION	FUNCTION
		TRANSPONDER
OSC		TEST SW in OSC position Crystal controlled OSC tuned for peak Proper Crystal for selected channel. (See Table 3-3)
		ALTERNATE POWER SUPPLY
POWER (Toggle Switch)	ON	Energizes the alternate power supply circuitry.
	OFF	De-energizes the alternate power supply circuitry.

TABLE 3-2. PRELIMINARY SETTINGS OF OPERATING SWITCHES

CONTROL	POSITION
MODE SW	OPER
TEST SW	BAT
PRIMARY POWER ANT	OFF
PRIMARY POWER TR	OFF
ALTERNATE POWER SUPPLY POWER (If used in place of battery)	OFF

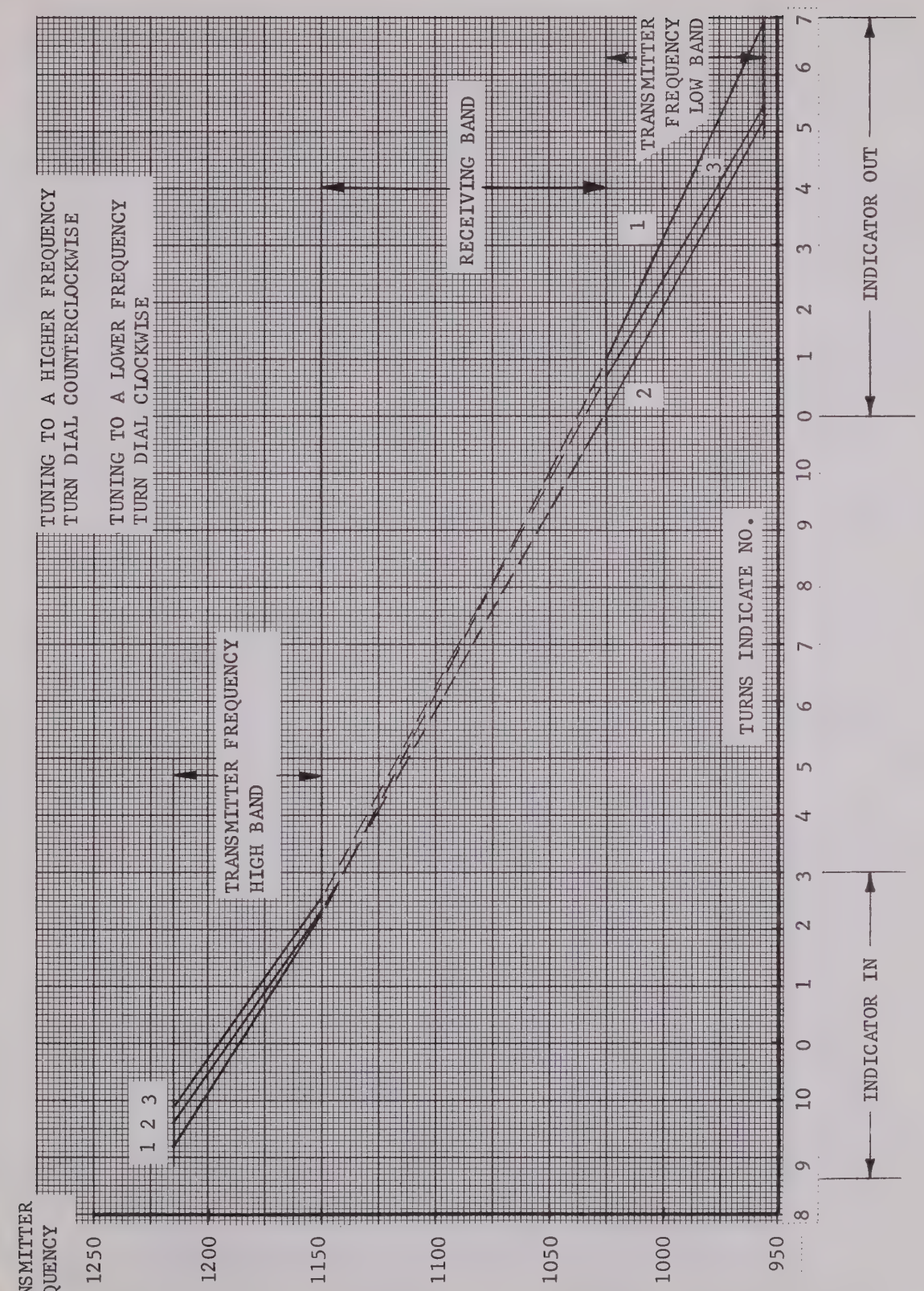


Figure 3-16. Power Amplifier Tuning Chart

(5) Step 5. Tune the POWER AMPLIFIER (1, 2 and 3) cavities with reference to the r-f power amplifier tuning chart. (See Figure 3-16.)

(6) Step 6. Select the proper crystal in accordance with frequency Table 3-3 and insert the crystal into the crystal socket that is located on the front panel and is marked R-F OSC.

(7) Step 7. Change cables, if applicable, by temporarily removing the card rack (1A2A1A1). The card rack is removed by loosening four mounting screws on the top of the transponder, after the transponder is removed from the case. Use duplexer cable marked with red for low band frequencies and duplexer cable marked with blue for high band frequencies. (See Figure 3-17.)

(8) Step 8. Turn PRIMARY POWER TR switch to ON.

(9) Step 9. Set TEST SW into position OSC.

(10) Step 10. Tune with tuning tool r-f OSC for a peak on the TEST METER.

(11) Step 11. Set TEST SW into position CAV.

(12) Step 12. Tune tuning knob of XMTR MULT CHAIN cavity Z2 for a peak on the TEST METER.

Note

To tune the cavity to the right frequency the following rule must be obeyed to avoid ambiguity of the frequency tuning.

For low band (Channel No. 1 to 63) the setting of the tuning knobs Z2 and Z1 are in the area close to the front panel between the numbers 1 and 4 stamped on the right hand side of the shaft under the knob. Each engraved ring on the shaft is numbered from 1 to 10 from the front panel out.

For the high band (Channel No. 64 to 126) the knob is turned out farther away from the front panel and the tuning range is between the numbers 7 and 10.

(13) Step 13. Tune XMTR MULT CHAIN BUFF, AMPL, DRIVE for peak on TEST METER.

(14) Step 14. Set TEST SW to LO.

(15) Step 15. Tune tuning knob of LO MULT CHAIN cavity Z1 for a peak on TEST METER.

Note

To tune the cavity to the right frequency the following rule must be obeyed to avoid ambiguity of the frequency tuning.

For low band (Channel No. 1 to 63) the setting of the tuning knobs Z2 and Z1 are in the area close to the front panel between the numbers 1 and 4 stamped on the right hand side of the shaft under the knob. Each engraved ring on the shaft is numbered from 1 to 10 from the front panel out.

For the high band (Channel No. 64 to 126) the knob is turned out farther away from the front panel and the tuning range is between the numbers 7 and 10.

(16) Step 16. Tune AMPL and DRIVE on LO MULT CHAIN for peak on TEST METER.

(17) Step 17. Re-peak cavity Z1.

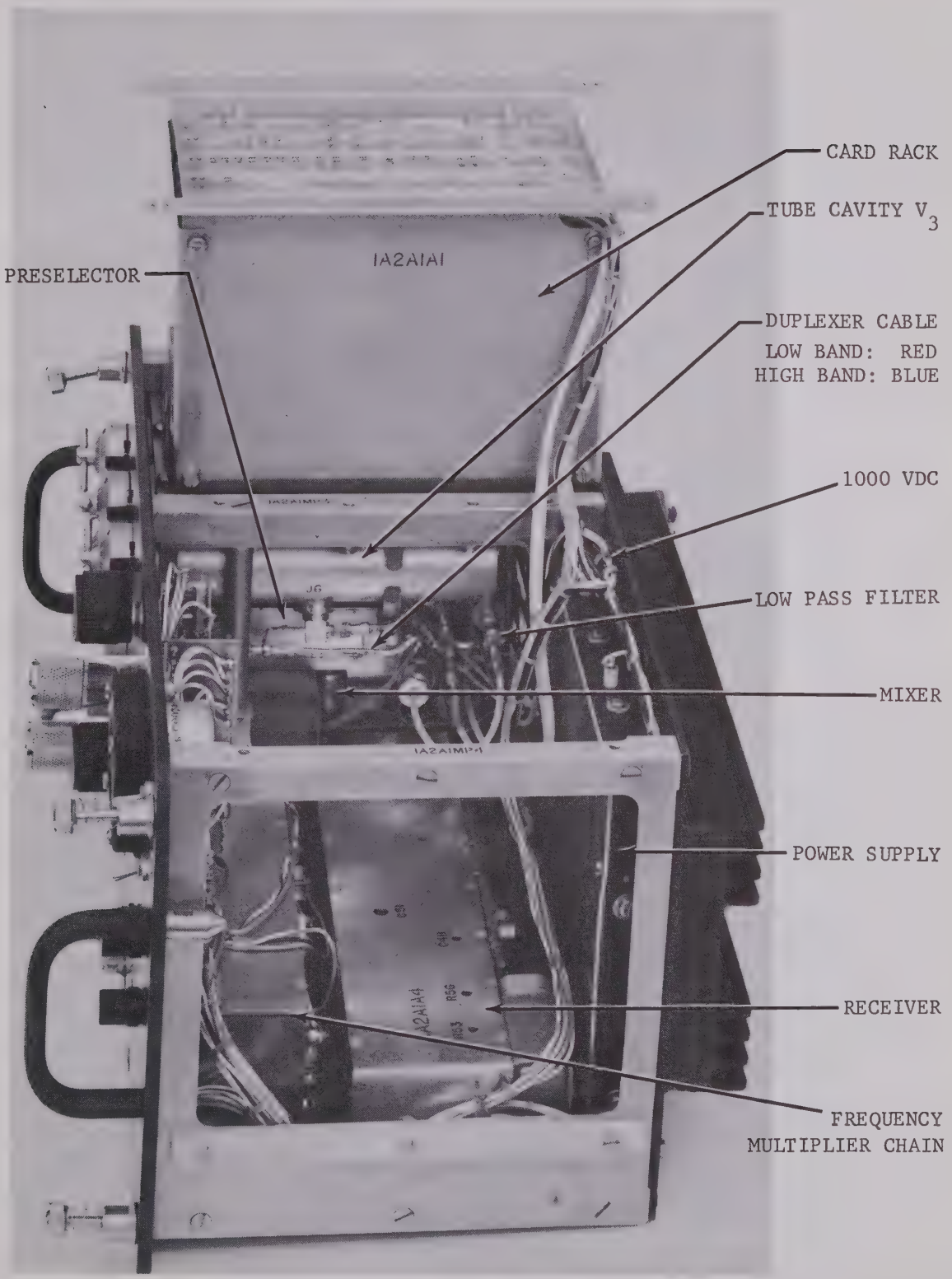


Figure 3-17 Duplexer Cable. (Red Color Indicates, Low Band Frequency; Blue Color Indicates High Band Frequency.)

(18) Step 18. Place TEST SW into PWR AMP position.

(19) Step 19. Place MODE SW into OPER position.

(20) Step 20. Re-peak the three POWER AMPLIFIER cavities 1, 2 and 3 as well as all tuning adjustments (BUFF, AMPL, DRIVE, Z2) of the XMTR MULT CHAIN.

(21) Step 21. Switch PRIMARY POWER ANT to ON.

The equipment is now operating.

3-5. SUMMARY OF OPERATING PROCEDURES.-

a. STARTING PROCEDURE.-

STEP	CONTROL	ADJUSTMENT	TEST METER SETTING	TEST METER READING
1	RCVR Preselector	Check according to tuning chart Figures 3-15a and 3-15b for proper frequency	-	-
2	OSC	Check proper crystal frequency	-	-
3	Power Amplifier	Check according to tuning chart Figure 3-16 for proper frequency	-	-
4	POWER Alternate Power Supply	POWER ON if applicable		
5	PRIMARY POWER TR	PRIMARY POWER TR ON	-	-
6	PRIMARY POWER ANT	PRIMARY POWER ANT ON		
7	MODE SW	OPER	-	-
8	Power Amplifier-Caps XMTR MULT CHAIN TUNE	Power Amplifier 1, 2, and 3 and XMTR MULT CHAIN BUFF, AMPL, DRIVE Cavity Z2	PWR AMP	Peak tuning

b. STOPPING PROCEDURE.

STEP	CONTROL	ADJUSTMENT	TEST METER SETTING	TEST METER READING
1	PRIMARY POWER AT	POWER OFF	-	-
2	PRIMARY POWER TR	POWER OFF	-	-
3	POWER Alternate Power Supply	POWER OFF if applicable	-	-

c. TUNING ADJUSTMENTS.-

1	PRIMARY POWER TR	POWER OFF	-	-
2	PRIMARY POWER ANT	POWER OFF	-	-
3	MODE SW	Set To Tune	-	-
4	RCVR Preselector	Tune in accordance with chart, Figure 3-15A or B		
5	Power Amplifier	Tune in accordance with chart, Figure 3-16		
6	R-F OSC	Insert Crystal		
7	Cables	Use duplexer cable marked with red for low band frequencies and duplexer cable marked with blue for high band frequecies		
8	PRIMARY POWER TR	POWER ON		
9	TEST SW	Place TEST SW into position OSC	OSC	
10	R-F OSC	Tune R-F OSC for peak	OSC	Peak
11	TEST SW	Place TEST SW into position CAV	CAV	

c. TUNING ADJUSTMENTS (Cont)

STEP	CONTROL	ADJUSTMENT	TEST METER SETTING	TEST METER READING
12	XTMR MULT CHAIN TUNE	Tune for peak on MULT CHAIN Cavity Z2 (See Note)	CAV	Peak
13	XMTR MULT CHAIN: BUFF, AMPL, DRIVE	Tune for peak	CAV	Peak
14	TEST SW	Set TEST SW into LO position	LO	
15	LO MULT CHAIN Cavity Z1	Tune for peak (See Note)	LO	Peak
16	LO MULT CHAIN AMPL, DRIVE	Tune for peak	LO	Peak
17	Cavity Z1	Re-peak	LO	Peak
18	TEST SW	Set TEST SW to PWR AMP	PWR AMP	
19	MODE SW	Set to OPER	PWR AMP	
20	POWER AMPLIFIER: No. 1, 2, and 3 XMTR MULT CHAIN: BUFF, AMPL, DRIVE, and Z2	Re-tune for peak	PWR AMP	Peak
21	PRIMARY POWER ANT	Set to ON	PWR AMP	

Note

For low band (Channel No. 1 to 63) the setting of the tuning knobs Z2 and Z1 are in the area close to the front panel between the numbers 1 and 4 stamped on the right hand side of the shaft under the knob. Each engraved ring on the shaft is numbered from 1 to 10 from the front panel out.

For the high band (Channel No. 64 to 126) the knob is tuned out farther away from the front panel and the tuning range is between the numbers 7 and 10.

3-6.- EMERGENCY OPERATION.-

Caution

Emergency operation should only be used when continued operation of the equipment is more important than possible damage to the equipment.

a. DISTANCE MEASURING ONLY.-

(1) The transponder can still be used to transmit only distance measuring information by positioning the PRIMARY POWER ANT switch to OFF. All other switches are placed in their normal position as instructed in paragraph 3-4. In this condition the transponder will continue to reply to interrogations thus supplying distance information but no bearing information.

(2) This mode of operation can be used if the antenna drive mechanism has become defective or if the battery voltage has become low and it is then desirable to conserve battery energy.

b. OPERATION OUTSIDE OF THE CASE.-

Warning

Operation of this equipment involves the use of HIGH VOLTAGES which are dangerous to life. Do not change transistors or components inside the transponder case with the power switch ON. Do not depend upon safety interlock switches for protection. Under certain conditions, dangerous potentials exist in the circuit with power controls in the OFF position due to charges retained by capacitors. To avoid shock and severe burns, always discharge and ground circuits before touching them. Never service or adjust the equipment without the presence or the assistance of another person capable of rendering first aid immediately.

If the transponder or alternate power supply must operate outside of its respective case for emergency maintenance purposes, the left interlock switch located on the back of the internal chassis must be cheated. This is accomplished by pulling the actuating rod out from its normal center position. The units can then be made operational by following the steps listed in paragraph 3-4b (3).

c. RECEIVER JAMMING.-

If the receiver is jammed by a CW signal, or failure of the receiver occurs, the transponder set will continue to transmit 15-Hz bearing information. In this particular case, the transmitter is not triggered by pulses whose origin is receiver noise or interrogation of an aircraft but instead is triggered by random pulses generated in the ARRC circuit.

3-7.- OPERATOR'S MAINTENANCE.

a. PERFORMANCE CHECK.- After the equipment has been started in accordance with the procedures outlined in paragraph 3-4, c., (2) above, the following check should be made to determine that the equipment is functioning properly. This procedure is not a complete operational performance check, but is intended only to give the operator reasonable assurance that the equipment is functioning normally. When checking the equipment, compare the readings obtained with the approximate readings in Table 3-4.

b. REPLACEMENT OF FUSES.-

Caution

Never replace a fuse with one of higher rating unless continued operation of equipment

is more important than probable damage, or unless authorized to do so. If a fuse blows immediately after replacement, do not replace it a second time until the cause has been located and rectified.

(1) The fuses used in the transponder are secured in fuseholders which do not have lamp indication of a blown fuse. When any apparent improper functioning of the equipment occurs, the fuses should be removed and visually checked before proceeding with any other tests. The fuseholders are located on the front panel of the transponder. A spare fuse is on the inside of the lid.

(2) The fuse used in the alternate power supply is secured in a fuseholder which has a neon lamp enclosed in its cap. This lamp glows to indicate a blown fuse. When any apparent improper functioning of the equipment occurs the illuminated fuseholder should be checked before proceeding with any other tests. This fuseholder is located on the front panel of the alternate power supply. A spare fuse for the alternate power supply is located on the back panel inside the alternate power supply.

TABLE 3-4. TEST METER READINGS DURING OPERATION

SETTING OF THE TEST SW	NORMAL READING (Approx.)
BAT	Mid Scale or Higher
21 V	Mid Scale
6.3 V	Mid Scale
12.6 V	Mid Scale
-12.6 V	Mid Scale
25.2 V	Mid Scale
1000 V	Mid Scale
OSC	Tuned for Peak
CAV	Tuned for Peak (Note 1)
PWR AMP	Tuned for Peak
LO	Tuned for Peak
OFF	

Note

A reading can only be obtained if MODE SW in in TUNE position.

SECTION 4

TROUBLE SHOOTING

4-1. GENERAL.

Section 4 discusses operating principles of the Manpack AN/TRN-22 (XN-1) and the relationship that exists between the individual functional blocks. This section also presents associated alignment and trouble shooting information.

4-2. OVERALL CIRCUIT DESCRIPTION. (Figure 4-1)

a. Distance interrogation signals received by the antenna are routed through the preselector and low-pass filter to the receiver mixer. At the mixer, the L-band signals are converted to an intermediate frequency of 63 MHz. These signals are then amplified logarithmically in the i-f amplifier and demodulated by the Ferris discriminator. The demodulated signal is amplified by the video amplifier and applied via a blanking gate to the level detector.

b. In order not to create a ring-around condition, the input of the level detector is gated during transmission of a pulse-pair by a blanking gate pulse-pair obtained from modulator circuit.

c. The level detector detects the half amplitude point on the logarithmically amplified pulse, by triggering a pick-off circuit at a point 6 db down from the peak of the pulse.

d. The negative going output pulse of the level detector is applied to the decoder. The decoder produces by means of a coincidence-type decoding circuit a single pulse for each interrogation or noise pulse-pair whose pulses are separated by 12 μsec.

e. The automatic sensitivity control circuit (ASC) receives decoded pulses from the decoder. It maintains the rate of decoded pulses constant at 1350 pps by controlling the gain of the i-f amplifier.

f. The decoder output pulse is also applied via an or-gate and an inhibit-gate to the control circuit.

g. If the receiver is jammed by a CW signal, or failure of the receiver occurs, the transponder will continue to transmit 15-Hz bearing information. In this case, the transmitter is not triggered by pulses whose origin is receiver noise or interrogation of an aircraft but instead is triggered by random noise pulses generated by the automatic repetition rate control (ARRC) circuit. The average noise pulse rate of the ARRC circuit is 1350 pps.

h. The output of the ARRC is also applied via the or-gate and inhibit-gate to the control circuit.

i. The same pulses which key the transmitter frequency multiplier chain are coupled through an or-gate to the inhibit-gate. Dead-time pulses are also applied to the inhibit-pulses through the or-gate.

j. The inhibit-gate circuit prevents any interfering signal, which might be generated in the ARRC circuit during transmission, from entering the control circuit. The dead-time provides echo-suppression and sufficient time for circuit recovery after each transmitted pulse-pair.

k. The control circuit processes the interrogation and/or squitter pulses coming from the receiver or from the ARRC circuit and provides the major part of the overall interrogation-reply delay. After each processed pulse, the dead-time gate is generated. In addition to the above, the circuit generates the north reference burst when a north reference

trigger pulse has been received from the antenna photo sensor circuitry. The control circuit assigns priority of transmission to the north reference burst signal over interrogation and squitter pulses.

1. The encoder receives trigger pulses from the control circuit. Each trigger pulse is converted into an approximately Gaussian shaped pulse-pair and superimposed on a pulse-pair pedestal. The modulator section receives the proper pulse-pairs and provides the power necessary to modulate the r-f power amplifier.

m. The crystal controlled oscillator provides the fundamental r-f signal from which the transmitter carrier and the LO frequency are derived.

n. The oscillator frequency is multiplied by the two doublers and a harmonic generator in the multiplier chain. The output signal of the harmonic generator is coupled into a resonant cavity that is tuned to the 6th harmonic of the incoming signal (the 24th harmonic of the oscillator frequency) for low band operation (962 to 1024 MHz) or tuned to the 7th harmonic of the incoming signal (the 28th harmonic of the oscillator frequency) for high band operation (1151 to 1213 MHz). The final amplifier stage of the transmitter frequency multiplier chain is gated on during transmission.

o. A portion of the signal is tapped off the second r-f amplifier stage of the transmitter frequency multiplier chain and applied to a second harmonic generator, the local oscillator frequency multiplier chain, for use as the receiver local oscillator signal which is fed to the balanced mixer.

p. About 200 mw (23 dbm) r-f peak power of the gated final stage of the transmitter frequency multiplier chain is applied to the cathode of the first stage of the three stage r-f power amplifier. The third stage delivers a minimum of 100 w r-f peak power to the antenna.

q. The r-f portion of the 15-Hz single lobe antenna consists essentially of a central array and a rotating parasitic reflector element. The parasitic element is driven at 900 rpm by a DC motor with a speed control circuit. A north reference trigger pulse is obtained by means of a photo-electric pick-off circuit. The antenna is mounted on an adjustable tripod. A magnetic compass is used to align the antenna with magnetic north; a bubble device on the compass is used to level the tripod.

r. The entire power supply consists of an external source, a voltage regulator, and a DC-DC converter supplying 5 DC voltages: 1000 V, 25.2 V, 12.6 V, 6.3 V, and -12.6 V.

4-3. OVERALL TROUBLE SHOOTING.

a. GENERAL.- The first phase is system trouble shooting and is designed to locate the unit in which the trouble occurs. In the second phase the trouble is to be located in the unit. Therefore, special attention should be given to the following:

(1) The relationship between the radio beacon AN/TRN-22 (XN-1) on the ground and the radio set AN/ARN -52 V in the aircraft, and how the radio beacon produces bearing and distance information;

(2) The function of the receiver-transmitter group, the battery (alternate power supply or any external DC source) group, the antenna group, and the relationship between these groups;

(3) The function of each of the units that make up the groups;

(4) The symptoms of malfunctioning in the radio beacon, any of the groups, and any component units of a group; and

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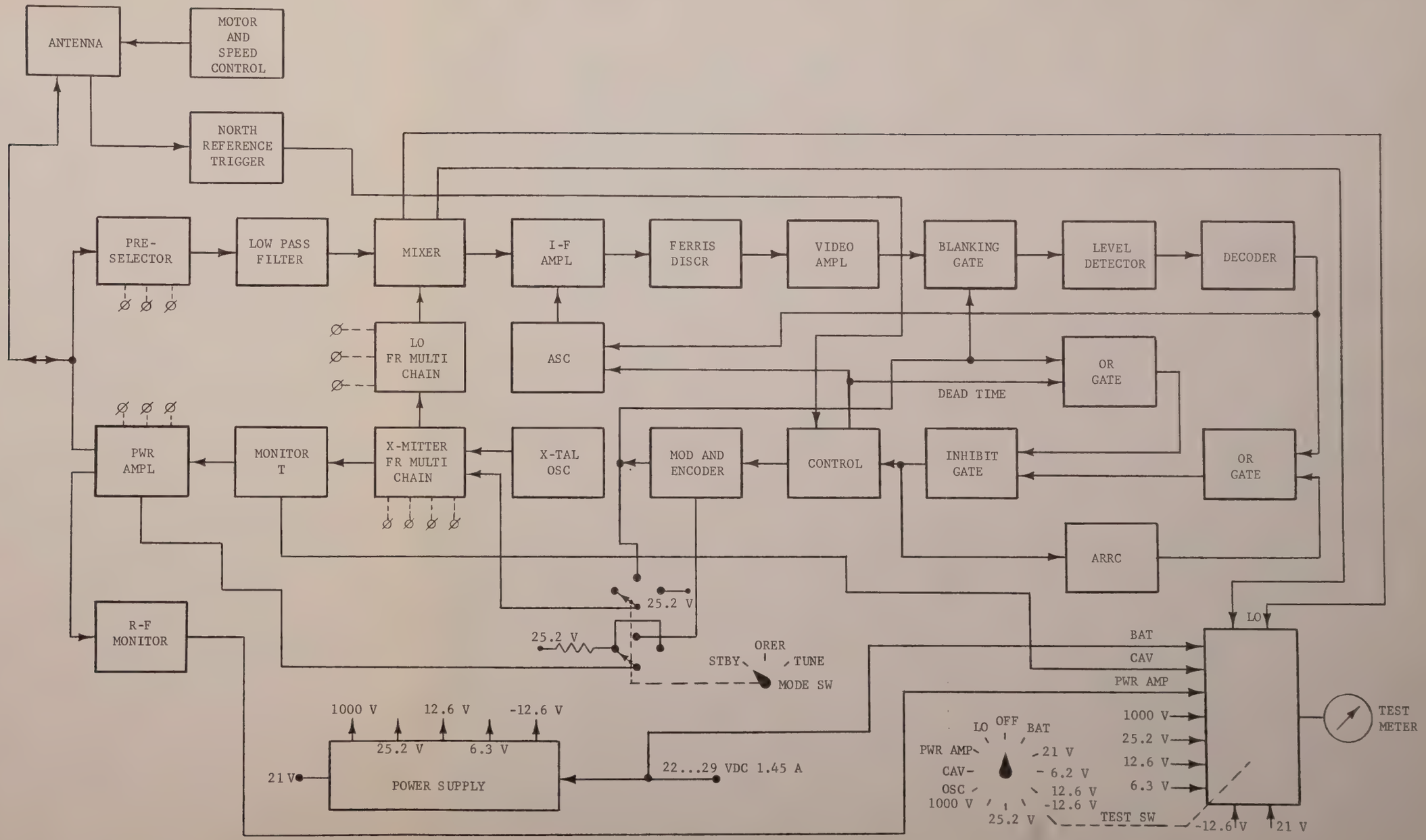


Figure 4-1 Overall Functional Block Diagram
AN/TRN-22 (XN-1)

(5) The most probable unit or circuits in which the observed trouble may be localized.

b. PRELIMINARY CHECK.- When servicing imperative equipment, localize the fault. This consists of localizing the defective component so valuable time will not be wasted in checking components that are in good operating condition. Localization can be accomplished by a visual inspection of the components in a logical sequence to determine which one is at fault. Refer to the various block diagrams and schematic diagrams for familiarization with the operational and signal sequence in the e-equipment. As soon as breakdown has been traced to a particular functional block, trace the fault to a particular stage or component responsible for the trouble.

c. VISUAL INSPECTION.- First make sure that all connectors are firmly seated and that all switches are in their proper positions. If no obvious defect is noticeable up to this point, carefully check for any visible signs of trouble such as over-heated resistors, no meter indication, an unlighted pilot lamp if the alternate power supply is being used, or any other abnormal indication. Once the fault is narrowed down to a particular section, consult the schematic diagram and illustration of the circuit to locate the defective part.

d. VOLTAGE MEASUREMENT.- Most faults encoutered in electronic equipment are a result of abnormal voltages. First make sure that all voltages are delivered from the power supply to the circuit to be checked.

Warning

Operation of this equipment involves the use of HIGH VOLTAGE (1000 VDC) which is dangerous to life. Do not change any component inside the case with the primary power switch on. While making voltage measurement always connect the ground lead of the voltmeter first.

e. RESISTANCE MEASUREMENT.- First ascertain that all power is off before taking any resistance measurement. Discharge all high voltage capacitors with an insulated wire. Whenever the resistance of any part is measured and found to be abnormally low, consult the schematic diagram to determine if other circuit elements are in parallel with this part. Before replacing this part, unsolder one terminal and repeat resistance measurement to eliminate any error caused by parallel components.

f. WAVEFORM COMPARISON.- Waveform comparison will often quickly reveal the malfunction of a circuit. Comparing the observed waveform on an oscilloscope to the reference waveform will permit rapid localization of a fault. Idealized waveforms are given in functional block diagrams or in schematics, respectively. In addition, waveform photographs at important test points are supplied to give the operator an exact comparison with a normal waveform. It should be mentioned that test equipment characteristics, or frequent usage, especially probes of oscilloscopes, can distort the observed waveform. A minor departure from the reference waveform is not regarded as significant unless the nature of the departure might indicate a fault. Special attention should be paid to the ground lead of probes. Always connect the ground lead to the closest ground terminal of the circuit to be tested.

Note

During trouble shooting, maintenance, or repair (when the transponder is not in its case) never feed transmitter, r-f output power to the antenna but use a dummy load instead. Generative feedback might occur which may cause a ring-around; the duty cycle can increase and thus overload the tubes.

4-4. RECEIVER.

a. FUNCTIONAL DESCRIPTION.-

(1) GENERAL.- The receiver (Figure 4-2) performs the following functions:

(a) Receives from the antenna the interrogation pulse-pairs transmitted by the aircraft;

(b) Converts the received distance interrogation pulse-pairs, along with random noise pulses generated within the mixer into an intermediate frequency of 63 MHz, and amplifies and demodulates these signals, including noise pulses generated in the i-f amplifier; and

(c) Maintains (by adding squitter pulses) a constant output at 1350 ±135 pulses per second of the decoder, regardless of the interrogation rate.

The receiver includes the following:

(a) Preselector;

(b) Low-pass filter;

(c) Balanced mixer;

(d) I-F amplifier;

(e) Ferris discriminator

(f) Video amplifier; and

(g) Automatic sensitivity control.

(2) PRESELECTOR.-

(a) The antenna is utilized for transmission and reception. The length of the cable from the common point A (Figure 4-3) to the input terminal of the preselector and to the output terminal of the transmitter power amplifier is such that during reception of interrogation pulses, the impedance between the antenna and power amplifier is high and the impedance between antenna and preselector is 50 Ω. During transmission of reply and squitter signals, the impedance between antenna and transmitter power amplifier is 50 Ω but is high between transmitter and receiver/preselector.

(b) The preselector is located in front of the low-pass filter F1 and r-f mixer. It consists of three individually tunable cascaded cavities. Tuning is achieved by varying the depth of penetration of a metal slug in each cavity. The preselector may be tuned to any frequency from 1025 to 1150 MHz. A graph (Figures3-15a and 3-15b) is provided for frequency versus tuning-indicator-setting information.

(3) LOW PASS FILTER.- The low pass filter is a thirteen-section coaxial filter and is inserted between the preselector and the mixer. The filter input and output are matched to 50 Ω impedance. The filter provides at least 50 db rejection to interfering r-f signals above 1650 MHz and prevents the mixer from being overloaded or damaged by strong radar transmitters in the "S", "X", and other higher frequency interfering bands.

(4) MIXER.- (Figure 4-4) The mixer is a balance type mixer. The local oscillator signal is fed into one arm of the mixer and the interrogation pulse-pairs are fed into the other arm. The resultant intermediate frequency of 63 MHz is amplified in the i-f amplifier. The DC current of the mixer diodes is utilized as an indication for proper peak -tuning of the LO frequency multiplier chain.

(5) I-F AMPLIFIER.-

(a) The i-f amplifier amplifies the interrogation pulses and random noise pulses, at the intermediate frequency of 63 MHz to a level sufficient to operate the Ferris discriminator. The gain characteristic of the i-f amplifier is logarithimic rather than linear. This results in a much wider dynamic range of

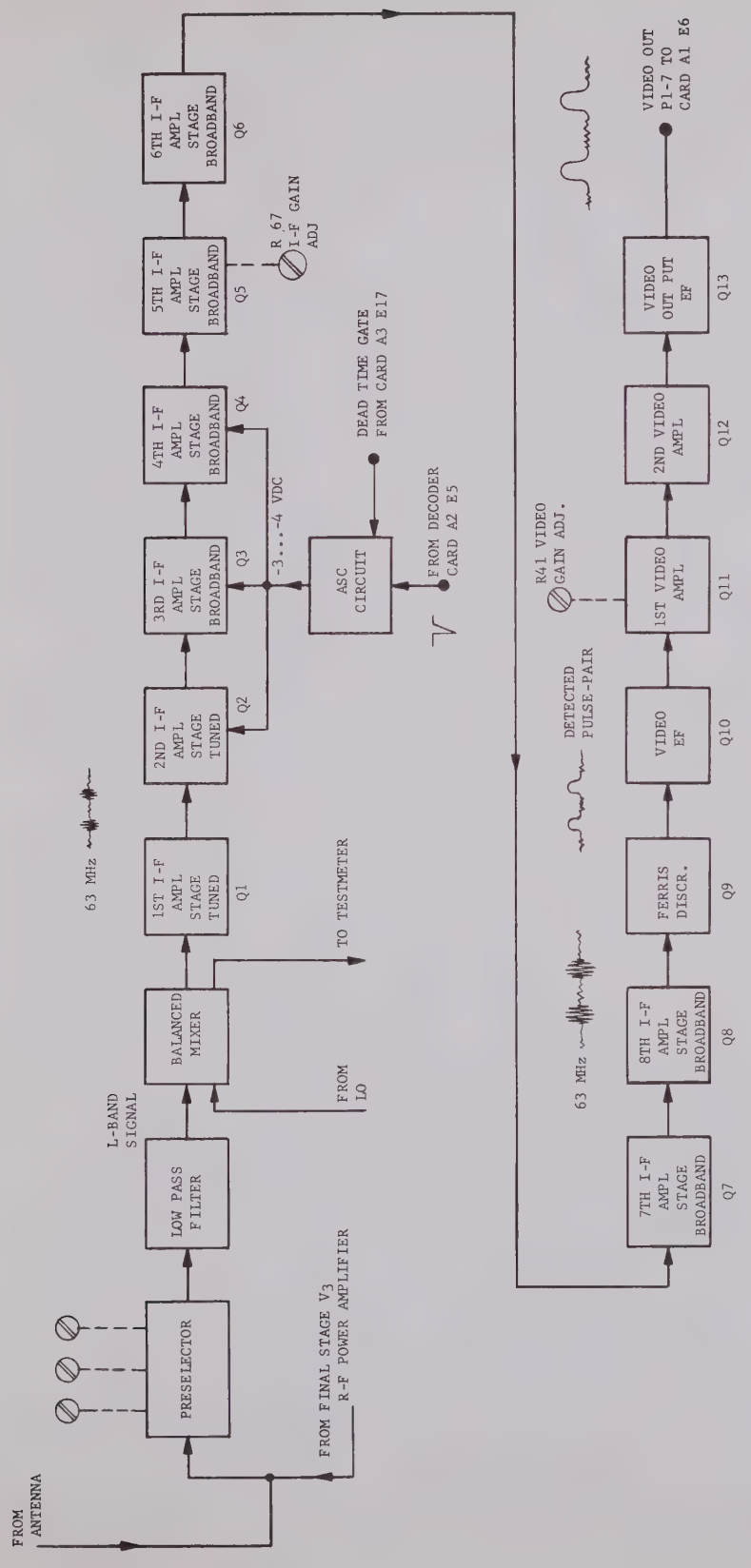


Figure 4-2. Receiver, Simplified Block Diagram

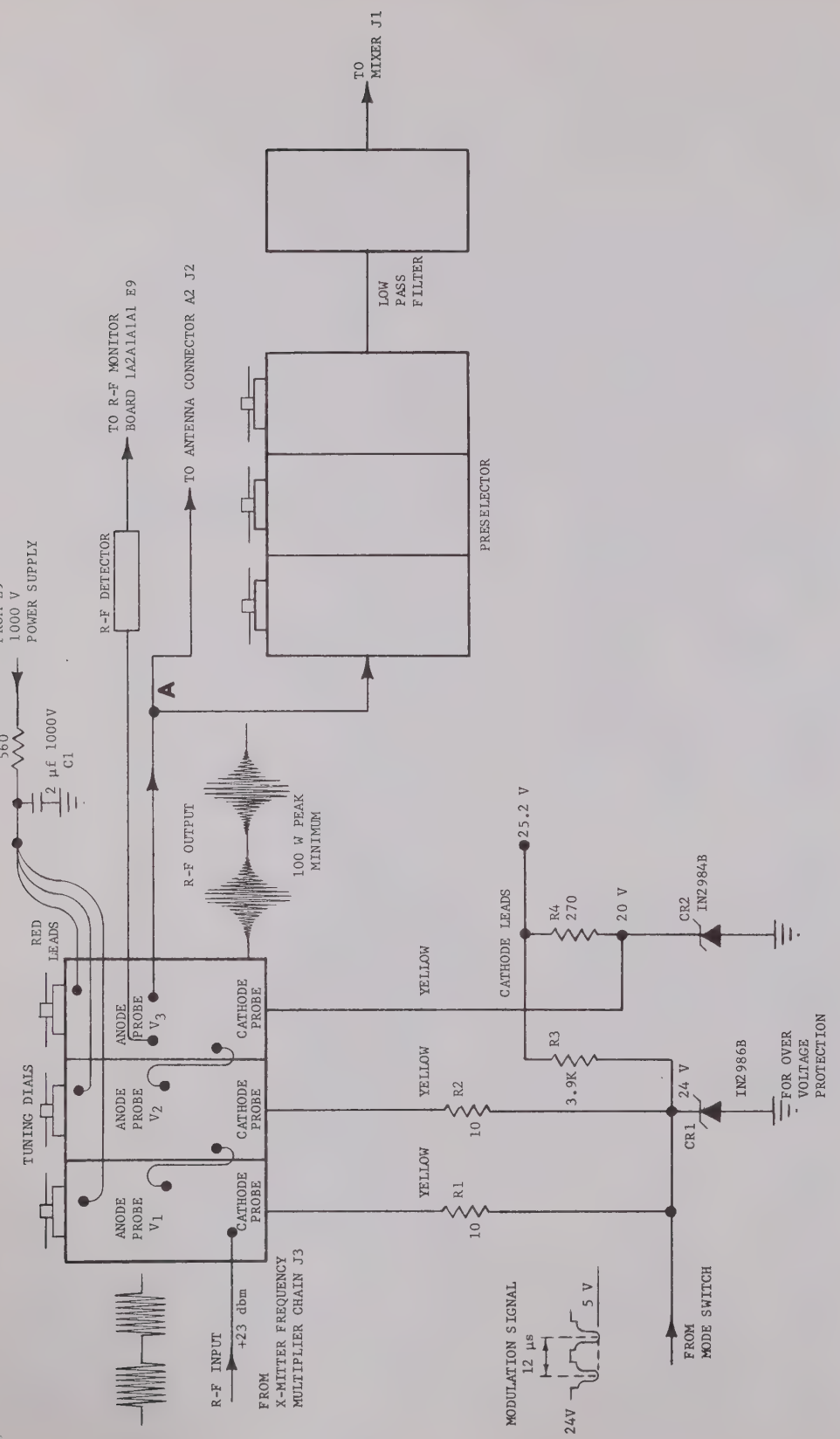


Figure 4-3. RF Power Amplifier, Preselector, and Associated Biasing Circuit, Functional Block Diagram

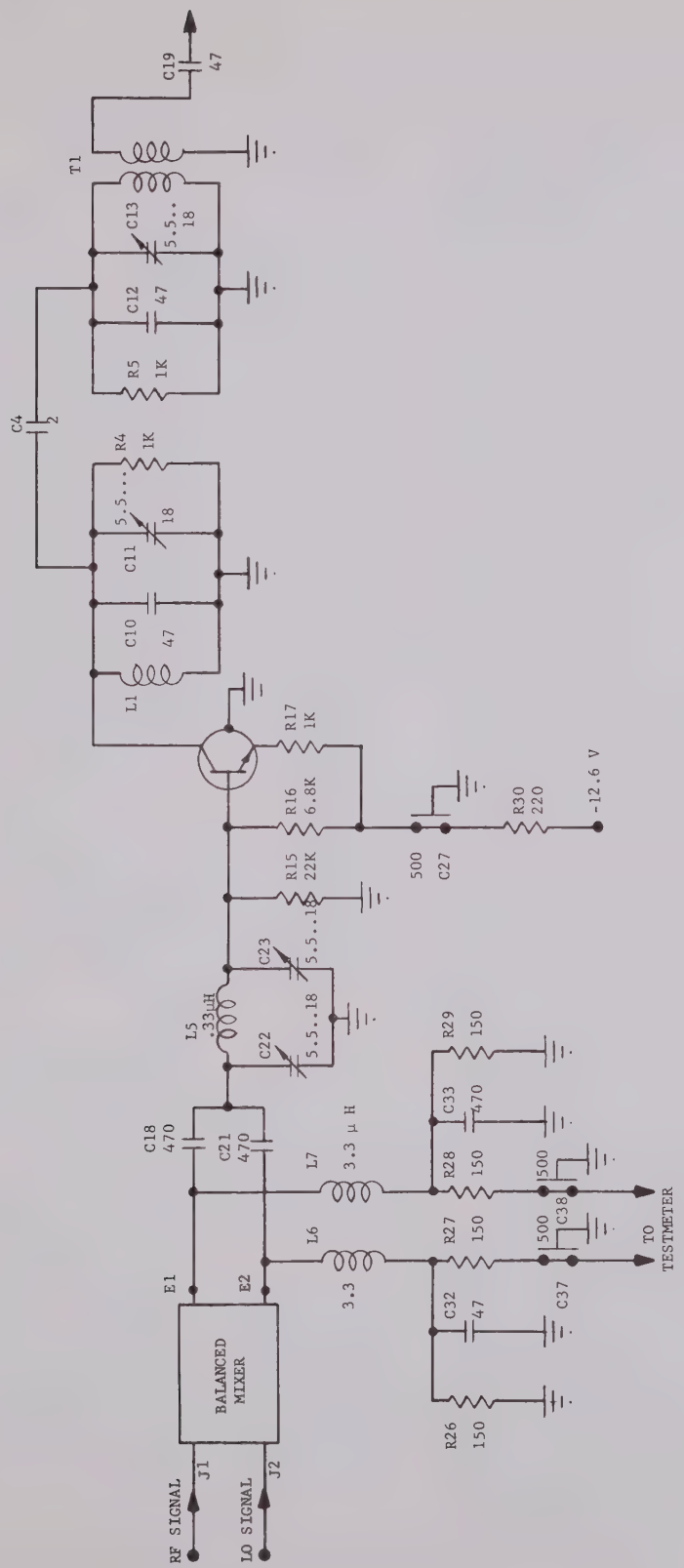


Figure 4-4. Mixer and First IF Amplifier Stage, Simplified Schematic Diagram

input signal levels without timing errors than a conventional linear amplifier.

(b) A network consisting of L5, C22 and C23 is a low-pass filter suppressing residual r-f and LO signals. (Figure 4-4) It also matches the mixer i-f output impedance to the i-f amplifier input impedance at 63 MHz. The resistors R22 and R16 are biasing resistors, and emitter resistor R17 stabilizes the quiescent point of transistor Q1. Resistor R30 and capacitor C27 is a power supply decoupling filter. By-pass capacitor C24 prevents degenerative r-f feedback. The collector circuit of Q1 is a double tuned capacitively coupled band-pass filter. Capacitors C11 and C13 are tuning capacitors. The second stage Q2 is inductively coupled to the second circuit of the band filter of the first stage. Generally, the second amplifier stage is like the first stage, except for the bias of the transistor which is controlled by the automatic sensitivity control circuit and for a clipping diode that has been added for very strong signals.

(c) The operation of the i-f amplifier stages Q3 to Q8 is similar; therefore, a detailed description will be confined to stage Q8 only. (Figure 4-5) Resistor R54 and R92 provide proper base bias of transistor Q8. Resistor R73 reduces somewhat the r-f gain of the amplifier stage. Capacitor C69 is an r-f by-pass and C70 a pulse by-pass. Because of the additional diode series resistor R56, if properly adjusted, the gain reduction is not abrupt but rather smooth. The nonlinear characteristic of the base-emitter junction causes a very strong r-f signal video detection. This provides an additional r-f signal compression. For a very low signal (about below -85 dbm) the gain characteristic of the i-f amplifier is linear. As the signal increases the last i-f amplifier stage, Q8, will reduce its gain by limiting the signal amplitude. With increasing signal amplitude, one stage after another starts to reduce gain. In this way an approximation of a logarithmic overall characteristic can be obtained.

(6) FERRIS DISCRIMINATOR. (Figure 4-6)

(a) The ferris discriminator is used to convert the interrogation pulses from the modulated i-f signal to a video signal. In addition, the ferris discriminator provides necessary adjacent channel rejection not obtainable by the i-f amplifier alone. The i-f signal is fed through C45 from the last i-f stage to the base of the discriminator driver transistor Q9. The output load of this transistor consists of two tank circuits tuned to a center frequency of 63 MHz. Tank circuit 1 (L13) has a "Q" approximately 3 times lower than that of tank circuit 2 (L14) which means the band-width of tank circuit 1 is 3 times wider than that of tank circuit 2. Both tank circuits are capacitively tapped at low impedance points thus preventing them from being affected by a load impedance.

(b) Diode CR3 will couple a negative signal across the output resistor R60 and R75 and diode CR8 will couple a positive signal.

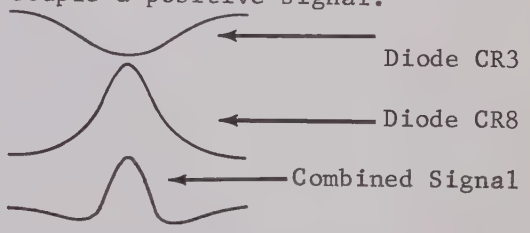


Figure 4-7. Frequency Response Curves of Ferris Discriminator

(c) The signal is the algebraic sum of both signals as shown in Figure 4-7. Thus the discriminator will produce positive output pulses for frequencies in the desired channel while frequencies below or above the desired channel will produce negative pulses.

(d) Since the video amplifier processes positive pulses only, a very good adjacent channel rejection can be obtained.

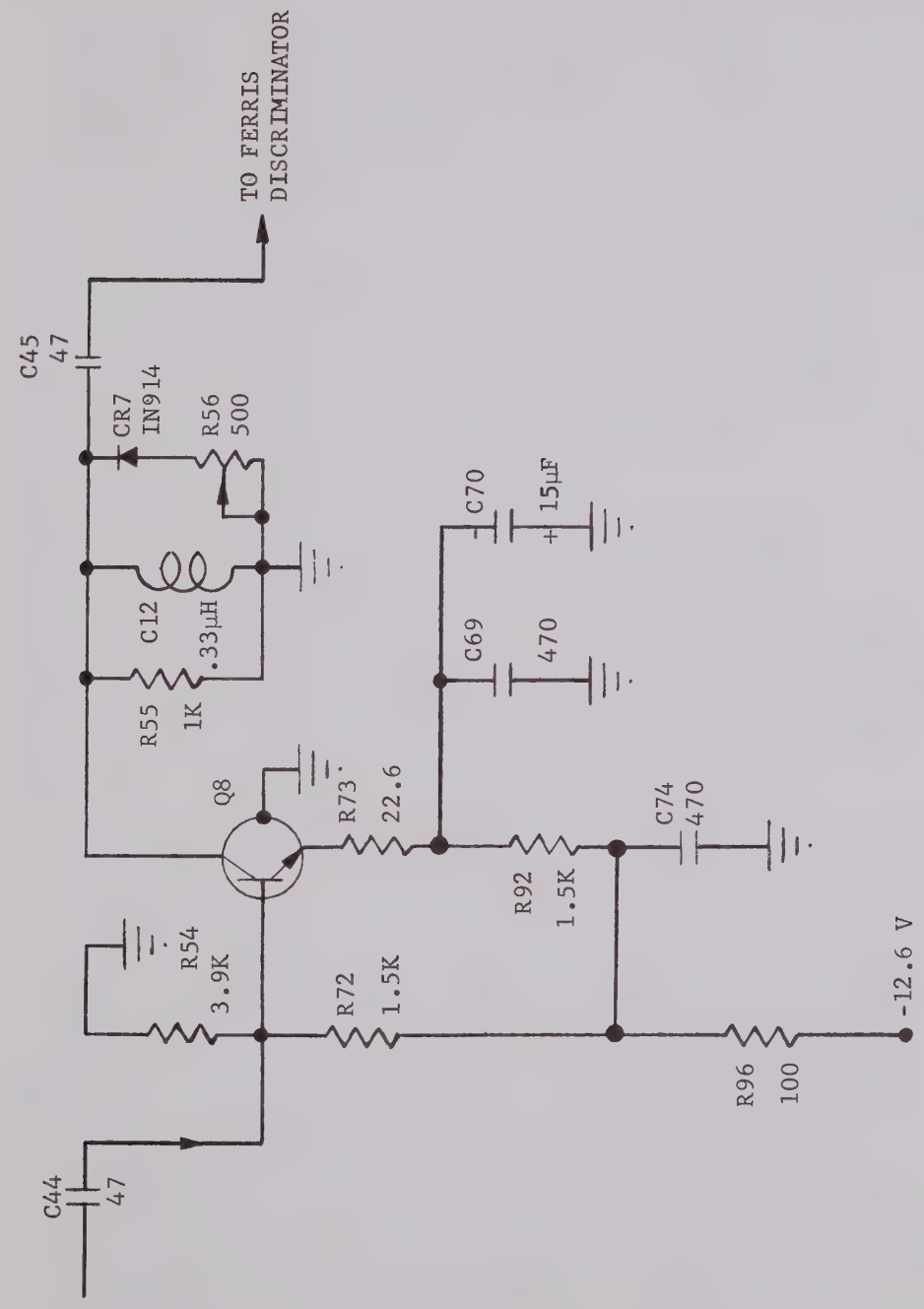


Figure 4-5. Broadband IF Amplifier Stage, Simplified Schematic Diagram

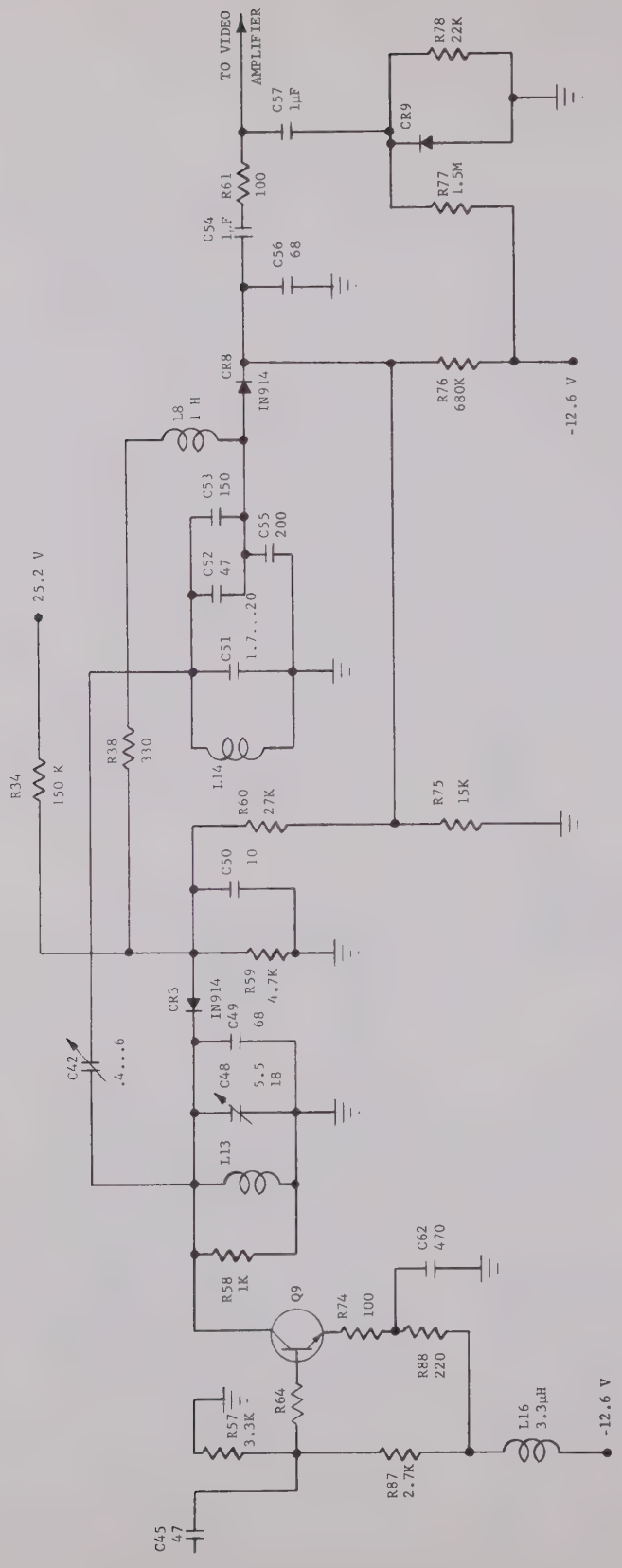


Figure 4-6. Ferris Discriminator, Simplified Schematic Diagram

(7) VIDEO AMPLIFIER.-(Figure 4-8)

(a) An emitter follower Q10 increases the input impedance of the video amplifier, thus preventing the ferris discriminator from being loaded down and degrading the selectivity of the discriminator. Diode CR9 at the input of the video amplifier clips excessive negative off-channel pulses. Resistor R77 pre-biases somewhat CR9 which makes it less temperature sensitive. Transistor Q11 is a linear amplifier the output amplitude of which is adjustable by means of variable resistor R41 (factory adjustment). The third stage, transistor Q12, is again a linear amplifier. Two sensistors stabilize the operating point and gain.

(b) The fourth stage is an emitter follower in class-B operation. Diode CR10 clips strong negative pulses avoiding DC shift of the operating point of transistor Q13. The diode CR11 in conjunction with resistor R44 compensates for the variation of the base-emitter voltage of transistor Q13 at different

(8) AUTOMATIC SENSITIVITY CONTROL.(ASC) (Figure 4-9).

(a) The automatic sensitivity control circuit maintains the rate of decoded pulses constant at 1350 ±150 pps. The ASC circuit receives decoded pulses from the decoder. This may also include interrogation pulses. They trigger a 4 μsec multivibrator Q2 and Q3 and the rate of the 4 μsec pulses is converted into a proportional DC (analog counter) voltage change by discharging capacitor C7. The transistor Q5 acts as a switch in isolating capacitor C7 from the multivibrator. The instantaneous voltage of capacitor C7 is applied to the base of differential amplifier Q4 (1) and an adjustable reference voltage to the other base of Q4 (2). If for example, the decoder pulse output rate tends to decrease below 1350 pps nominal, the charge voltage of capacitor C7 increases, thus transistor Q4 (1) and transistor Q1 draw more current and the base bias of the transistor Q2, Q3, and Q4 of the i-f amplifier goes more positive which will in turn increase the gain of the i-f amplifier. Diode CR1 prevents the ASC voltage from assuming positive voltage values with respect to ground. A higher gain of the i-f amplifier produces more decodable noise pulses at the input of the decoder and the nominal squitter rate of 1350 pps ±50% is restored. If the squitter rate tends to increase, the circuit works in the opposite manner. The proper squitter rate is adjustable by varying the reference voltage with the variable resistor R16.

(b) Decoded pulses at the output of the decoder cannot be distinguished if they are generated by random noise pulses or by interrogation signals. For this reason, when the number of the interrogation increases, the gain of the i-f amplifier will be reduced and the contribution of noise pulses to the squitter rate will decrease and vice versa.

(c) After acceptance of a decoded pulse-pair, a dead-time gate is generated in the control circuit. During the dead-time no pulse will be processed. To obtain the same pulse rate, counted by the ASC circuit, as pulses are further processed, the dead-time gate is fed to the transistor Q6 (inhibit gate) which disables during the dead-time the 4 μsec multivibrator, Q2, Q3, by clamping collector of Q2 to ground.

b. ALIGNMENT.-

(1) GENERAL.-

(a) The frequency channel of the i-f amplifier and Ferris discriminator is not an important factor because the LO signal and r-f signal are 63 MHz ±0.005% apart during alignment and the frequency channel used is in conformance with Table 3-3.

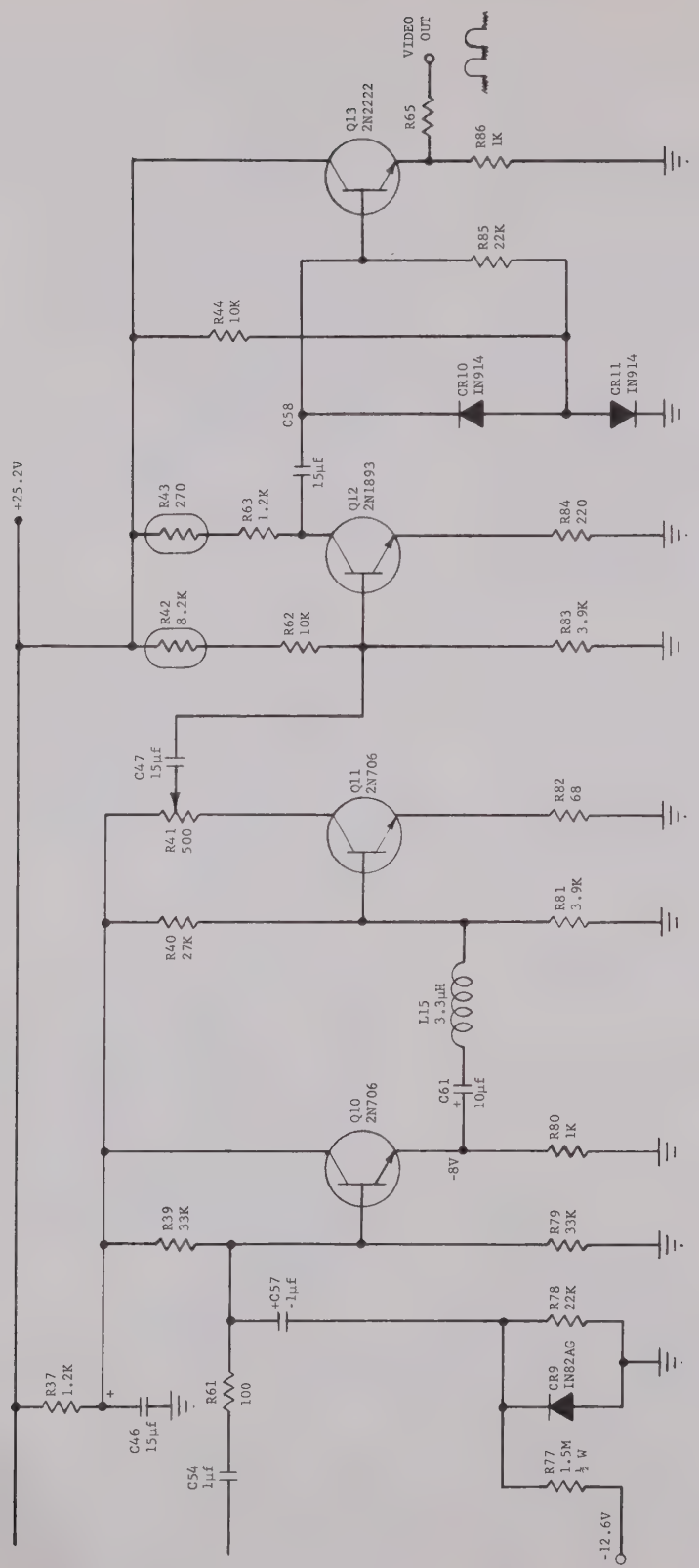


Figure 4-8. Video Amplifier, Simplified Schematic Diagram

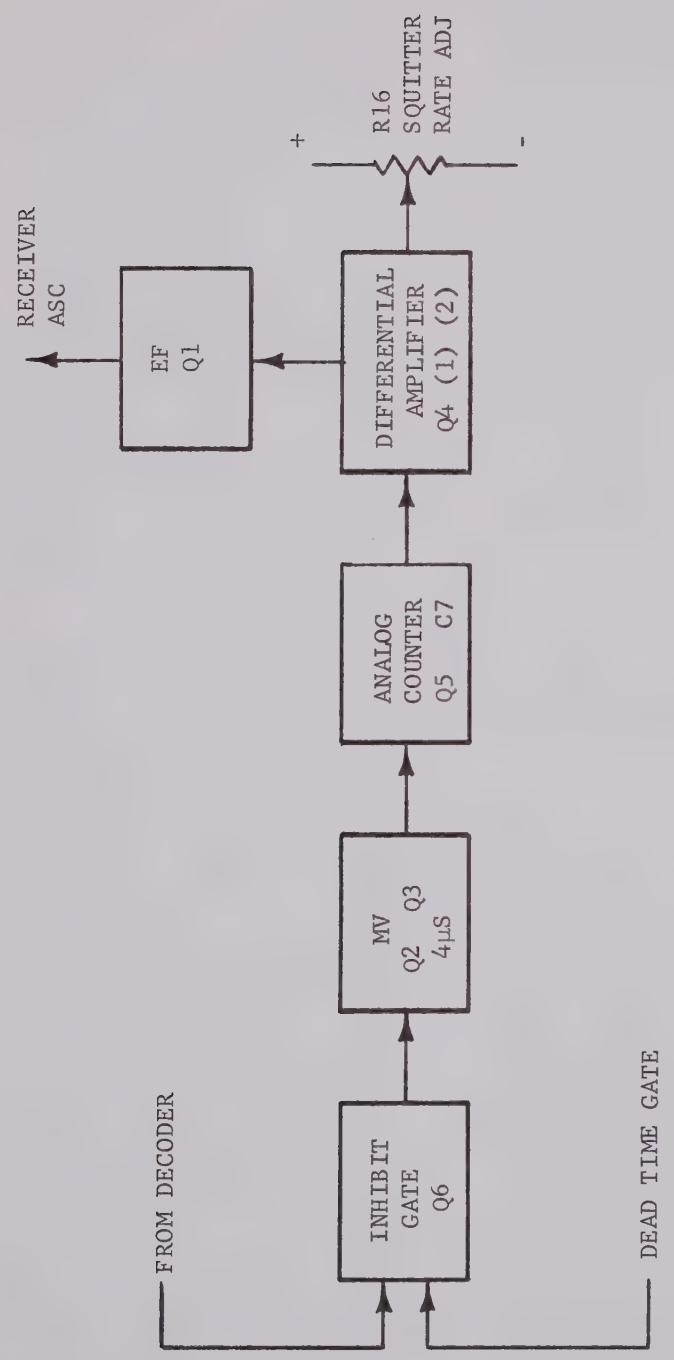


Figure 4-9. Automatic Sensitivity Control (ASC), Block Diagram

(b) Prior to alignment, check the r-f signal generator frequency and LO frequency. Ascertain that LO frequency multiplier chain is properly tuned.

(c) The r-f signal generator supplies an r-f signal with a Gaussian pulse modulation. Adjust signal generator for a repetition rate of 200 pulse-pairs per second and a pulse spacing of 12 μsec.

(2) I-F AMPLIFIER AND ASC CIRCUIT ALIGNMENT. (Figure 5-45)

(a) Disassemble receiver from transponder (See Paragraph 5-3 a(5) and remove top lid from receiver assembly, but do not disconnect connector P1 (DC supplies, video signal, and leads to the ASC circuit).

(b) Disconnect TNC connector from receiver mixer connector J1; then connect the r-f input signal and the signal generator to J1, and finally connect the rest of the test circuit as shown in Figure 4-55.

(c) Never connect the oscilloscope probe without having a 1K Ω ½ W decoupling series resistor attached to the 63 MHz i-f circuit. Keep the leads of the 1K Ω decoupling resistor and the ground lead of oscilloscope probe as short as possible. Always connect the ground lead of the probe to the chassis first before connecting the "hot" terminal of the probe to the circuit.

(d) After all connections have been made, turn on the signal generator and allow 15 minutes warm-up time. The transponder does not require any warm-up time. When aligning the receiver always set the MODE SWITCH into STNDBY position.

(e) Unsolder wire from the ASC circuit to feed-through capacitor C1 (See Figure 5-41,) and connect to the outside terminal of C1 a negative voltage as shown in Figure 4-55. If this connection is open the i-f amplifier cannot work.

(f) Set the variable (Figure 5-45) resistors R47, R50, R53, and R56 with tuning tool into center position. Adjust variable resistor R67 to about 80% of its full range. (clockwise)

(g) Turn on transponder and set the bias voltage on the auxiliary power supply for the transistors Q2, Q3, Q4 to -1 volt. Set the level of the signal generator and the gain of the amplifier of the oscilloscope just high enough that a 63 MHz pulse-pair is visible on the scope. Check the proper level and polarity setting of the external oscilloscope trigger pulse (obtainable from the signal generator) to insure that the entire pulse-pair is displayed on the oscilloscope.

(h) Tune with the tuning tool the variable capacitors C22, C23, C11, C13, C14, and C17 for a peak reading on the oscilloscope and decrease continually the output level of the signal generator. Basically use, for peak tuning of the i-f amplifier, the lowest signal generator output level which permits proper tuning. These controls interact and so it is necessary to readjust each control several times.

(i) Turn off transponder and connect the probe of the oscilloscope without series decoupling resistor to the video output of the receiver, accessible at the receiver chassis, Figure 5-40, or on the level detector board 1A2A1A1A1, terminal E6.

(j) Adjust variable resistor R41 for maximum gain (fully clockwise). Set variable capacitor C42 into center position.

(k) Turn transponder primary power on and set the gain of the amplifier of the oscilloscope for proper display. Set the time base to 10 μsec/cm.

(1) First tune capacitor C48 and then capacitor C51 for a peak on the oscilloscope. If necessary, readjust the output level of the signal generator so that the video signal is still distinguishable from noise. Repeat tuning of C48 and C51.

(m) Turn off transponder primary power, disconnect the auxiliary power supply from the transponder and resolder the wire from the ASC circuit to feed-through capacitor C1. Ground terminal E4 on board 1A2A1A1A3 (Figure 5-42). Connect counter capable of counting 10 MHz) to terminal E5 board 1A2A1A1A4 (control circuit output). Provide a good ground connection to the counter. Turn on transponder primary power. Adjust variable resistor R16 on ASC circuit (Figure 5-41) for a reading on the counter of 1300 pulses per second and set variable resistor R67 located on bottom of the receiver assembly 1A2A1 (Figure 5-36) for an ASC bias voltage measured between feed-through capacitor C1 (minus) and ground (plus) of -3.5 V. R16 and R67 interact so it is necessary to readjust the controls several times to obtain -3.5 V ASC bias for 1300 pps.

(n) Set signal generator level to -30 dbm. Adjust variable resistor R56 (Figure 5-39) for minimum video signal amplitude and increase video signal amplitude by turning R56 clockwise until the video signal reaches about 2 to 2.5 volts times the minimum value. Adjust preliminary R47 (Figure 5-36), R50 (Figure 5-36), and R53 (Figure 5-39) so that when varying the signal between -90 dbm and -30 dbm, the video signal amplitude assumes not more than 12 V peak and does not change the waveform considerably. If necessary, reduce the video amplifier gain by readjusting R41.

(o) Connect the oscilloscope probe to decoder output, board 1A2A1A1A2, terminal E5. (Figure 5-42) For satisfactory operation, the decoder must produce a single output pulse for each decoded receiver input pulse.

(p) If necessary, adjust variable resistors R47, R50, and R53 so that, when changing the signal generator level from -90 dbm to -30 dbm, the decoder output pulse does not shift more than ±0.25 μsec. The alignment of the i-f amplifier and video amplifier is now completed.

c. TROUBLE SHOOTING.-

(1) When the transponder does not operate properly and it is suspected that the receiver failed, check the following consecutively:

(a) Battery voltage on test meter;

(b) All DC power supply voltages on test meter;

(c) All r-f cables and connectors;

(d) Set MODE SWITCH into STNDBY position and check tuning of the preselector; and

(e) Tuning of LO frequency multiplier chain. If there is no positive meter indication, check mixer diodes and LO multiplier chain output power (paragraph 4-11c(2)).

(2) If the trouble connot be located, disassemble the receiver assembly from the transponder assembly (Paragraph 5-3a(5)) but do not electrically disconnect the receiver from the rest of the transponder. Visually inspect the circuit and measure all DC voltages as they are called out in the schematic diagram Figure 5-44. Check ASC bias voltage and measure the squitter rate of the receiver (ARRC circuit disabled) as described in the preceding paragraph.

(3) After a repair a realignment might be advisable. During trouble shooting, the MODE SWITCH should be in STNDBY position.

4-5. LEVEL DETECTOR.

a. FUNCTIONAL DESCRIPTION.- (Figures 4-10, 4-11, and 5-46)

(1) The logarithmically compressed input pulses from the receiver video and amplifier, plus noise generated within the receiver, are fed into the input emitter follower Q3. This emitter follower floats between plus and minus supplies and is therefore conducting in the absence of any input signal to avoid temperature drift of the offset voltage which would occur in a cut-off emitter follower. The output of this emitter follower is split into two channels: 1) A so-called "DC" channel which is AC coupled but stores detected DC information. This will be referred to as channel A; 2) An AC channel which delays by 3 μsec any input signal for comparison in a later stage. This will be referred to as channel B.

(2) Channel A is essentially a voltage delayed peak detector, i.e., peak detection does not take place until a fixed voltage bias is overcome. C6 will charge up to the peak voltage of the incoming signal minus this bias which is zenar referenced by CR4. The detection diode is CR2.

(3) It can be proven mathematically that this detection method, (subtracting a fixed voltage from the peak input signal) does correspond with a 6 db down point of the signal referenced to the antenna input--regardless of input level over a large dynamic range. CR3 functions to compensate for drift in offset voltage of detector diode CR2.

(4) The detected DC voltage is isolated from the tunnel diode comparator circuit CR1, Q6 by a high impedance dual emitter follower--again floating for the above mentioned reason.

(5) Channel B delays any input signal 3 μsec by means of delay line DL-1. For symmetrical reasons, an identical dual emitter follower is employed as a coupling to the comparator circuit. This assures similar drift characteristics in both channels. Percentual attentuation in the delay line is equalized with tracking adjust R24 in channel A.

(6) For comparison of the two channel outputs a tunnel diode pickoff is used. An output pulse is produced when the tunnel diode anode becomes positive with respect to the cathode. Signal pickoff is at the collector of Q6. The inverted signal at the collector of Q8 serves at output to the following decoder circuit.

(7) The output signal is also used to initiate a delayed reset pulse for channel A timing capacitor C6. A 6 μsec delay is incorporated to allow for signal decay in the delay line. The trailing edge of the 6 μsec delay MV consisting of Q12 and Q14 triggers a 1 μsec reset pulse generator. The output of the multivibrator saturates reset transistor Q7 via emitter follower Q5.

(8) In order to avoid a ring-around condition, the input of the level detector is gated during transmission of an output pulse-pair by a blanking pulse-pair obtained from modulator circuit.

(9) During partial coincidence of an interrogation or squitter pulse with an output pulse, it is possible that the resultant chopped-off input pulse is attentuated in the delay line because of its low pass frequency characteristic. The "DC" channel responds normally to the peak. This condition does not result in an output pulse and consequently C6 is not reset--creating a prebias for the next pulse which may even be blocking in nature. To avoid this situation the trailing edge of the blanking gate is also used to create a reset pulse.

(10) A simplified timing chart (Figure 4-12) is presented to clarify the above description. Actual signal pictures (under normal operating conditions) may be found at the end of this section.

b. ALIGNMENT.-

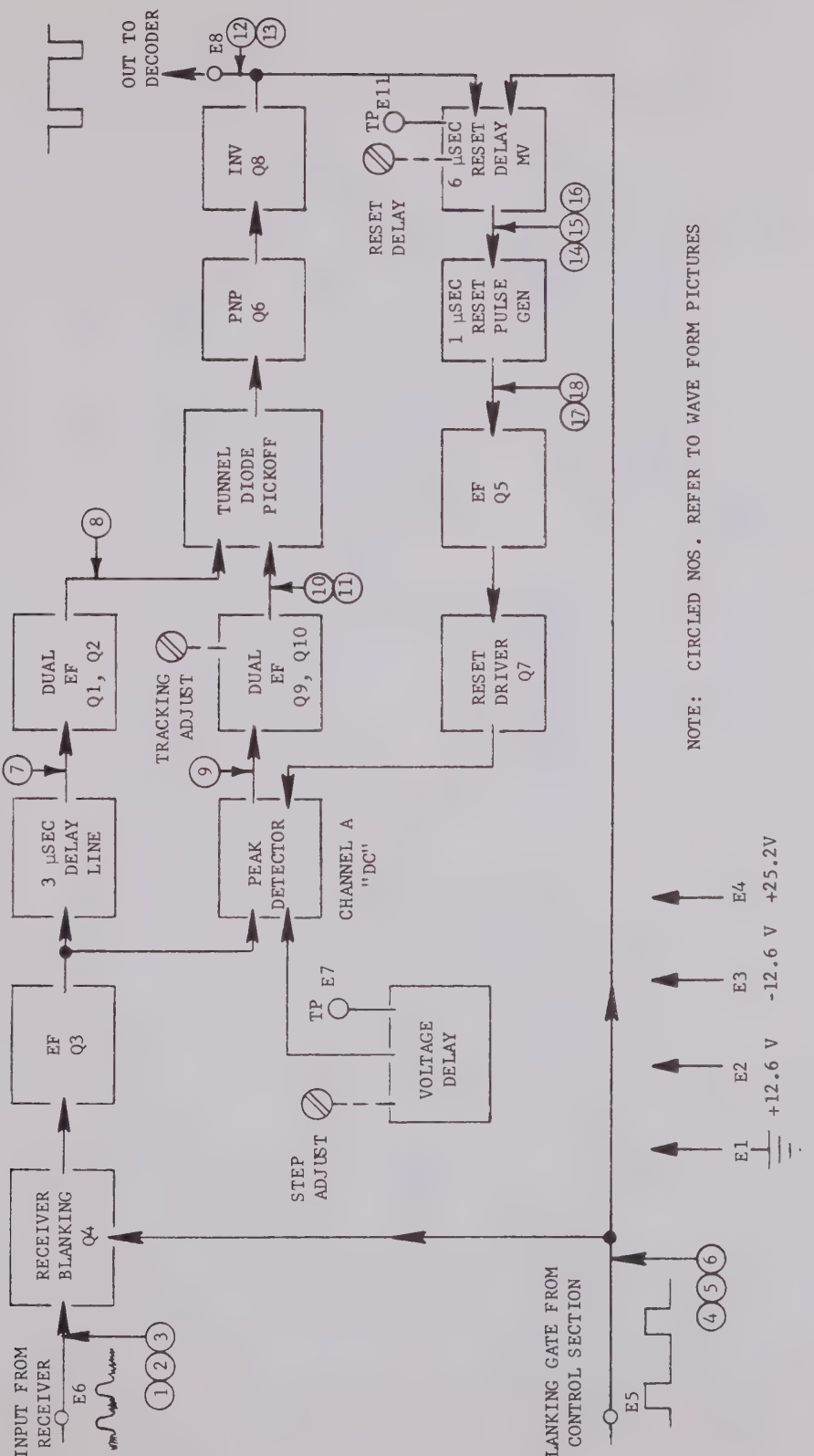


Figure 4-10. Level Detector, Block Diagram

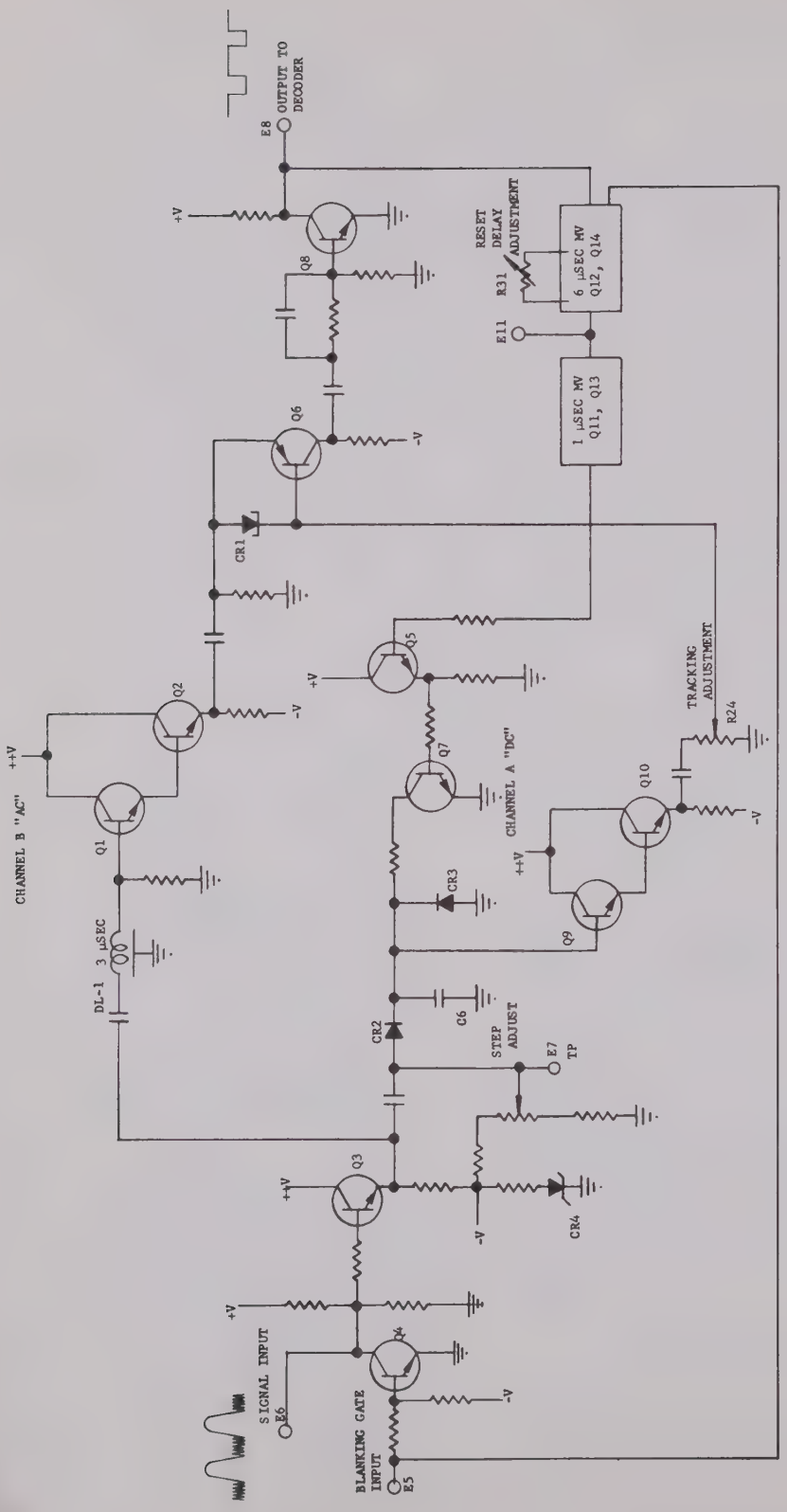


Figure 4-11. Level Detector, Simplified Schematic Diagram

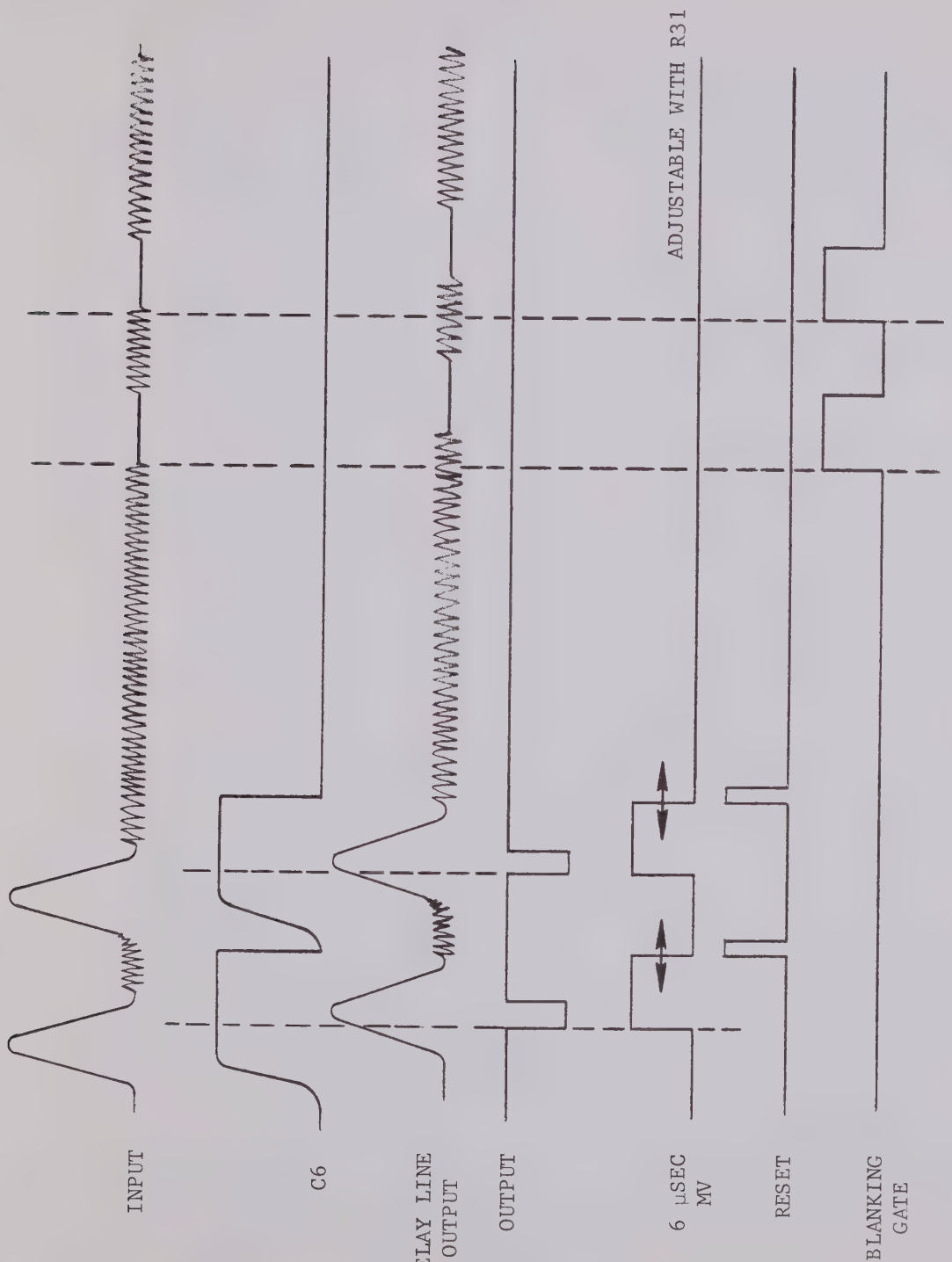


Figure 4-12. Level Detector, Timing Chart

(1) Voltage of test point E7 should be adjusted to 1.2V as measured with voltmeter.

(2) Tracking adjust pot R24 set so timing error (as measured from reference point of signal going into the receiver to signal at output terminal E8) is minimum when input signal is varied over full dynamic range.

(3) Reset delay MV is set to 6 μsec by adjusting R31 test point E11 scope internal sync. positive.

c. TROUBLE SHOOTING.- (Figures 4-10, 4-11, and 5-56)

(1) For trouble shooting purposes, a set of waveform pictures taken under normal operating conditions after proper alignment is included at the end of this section. (Figures 4-33 through 4-54) The encircled numbers in the schematic and block diagrams refer to signal point and picture numbers. A summary of the waveform photographs is presented in Table 4-1 at the end of this section. (Pictures 1 through 18)

(2) Absence of an output signal at E8 due to a malfunction in the circuit will, however still result in a blanking gate input--in this case randomly generated in the ARRC circuit.

(3) A failure of the reset circuits prevents capacitor C6 in the peak detector from discharging. This, in turn, pre-biases the tunnel diode which cannot fire, at least not until the charge on C6 has leaked off.

(4) The blanking gate input should result in triggering both multivibrators. Any failure should be traced to the point where signal is lost, and followed by examination of the parts in that vicinity.

4-6. DECODER.

a. FUNCTIONAL DESCRIPTION. (Figures 4-13, 4-14, and 5-47)

(1) The purpose of the decoder is to supply an output pulse for every pulse-pair from the level detector spaced 9-15 μsec whether squitter or resulting from an interrogation.

(2) Any so called first pulse is temporarily stored in a delay line and will only produce an output pulse if a following pulse is properly spaced from the previous one.

(3) In case there are legitimate interrogations, an output pulse time-referenced to the first pulse is produced thereby reducing timing errors which may result in echoes in case the second pulse decoding is utilized.

(4) The negative incoming pulses (from the level detector) trigger a 4 μsec pulse shaper multivibrator Q11, Q12.. Its output enters delay line DL1 via emitter follower Q13. The same input pulses are differentiated and via emitter follower Q1 applied to a negative going AND gate, CR1, CR6. This gate is not yet conditioned so the first pulse does not pass.

(5) After 9 μsec have elapsed the signal in the delay line arrives at the appropriate tap and is, via emitter follower Q16, applied to tunnel diode pickoff circuitry, CR16, Q17 and the resulting output via emitter follower Q18 sets flip-flop Q2, Q3 thereby conditioning the AND gate. Any second pulse will pass this gate until the gate closes because of reset of the flip-flop. This takes place 6 μsec lacer at which time original input signal arrives at end of the delay line. Identical pick-off circuitry is utilized.

(6) As said before, a second pulse will pass the AND gate when it occurs within the 6μsec window. It will activate the 7μsec multivibrator Q6, Q7 which in turn opens NAND gate CR2, CR11.

(7) If the first pulse arrives at the end of the delay line after

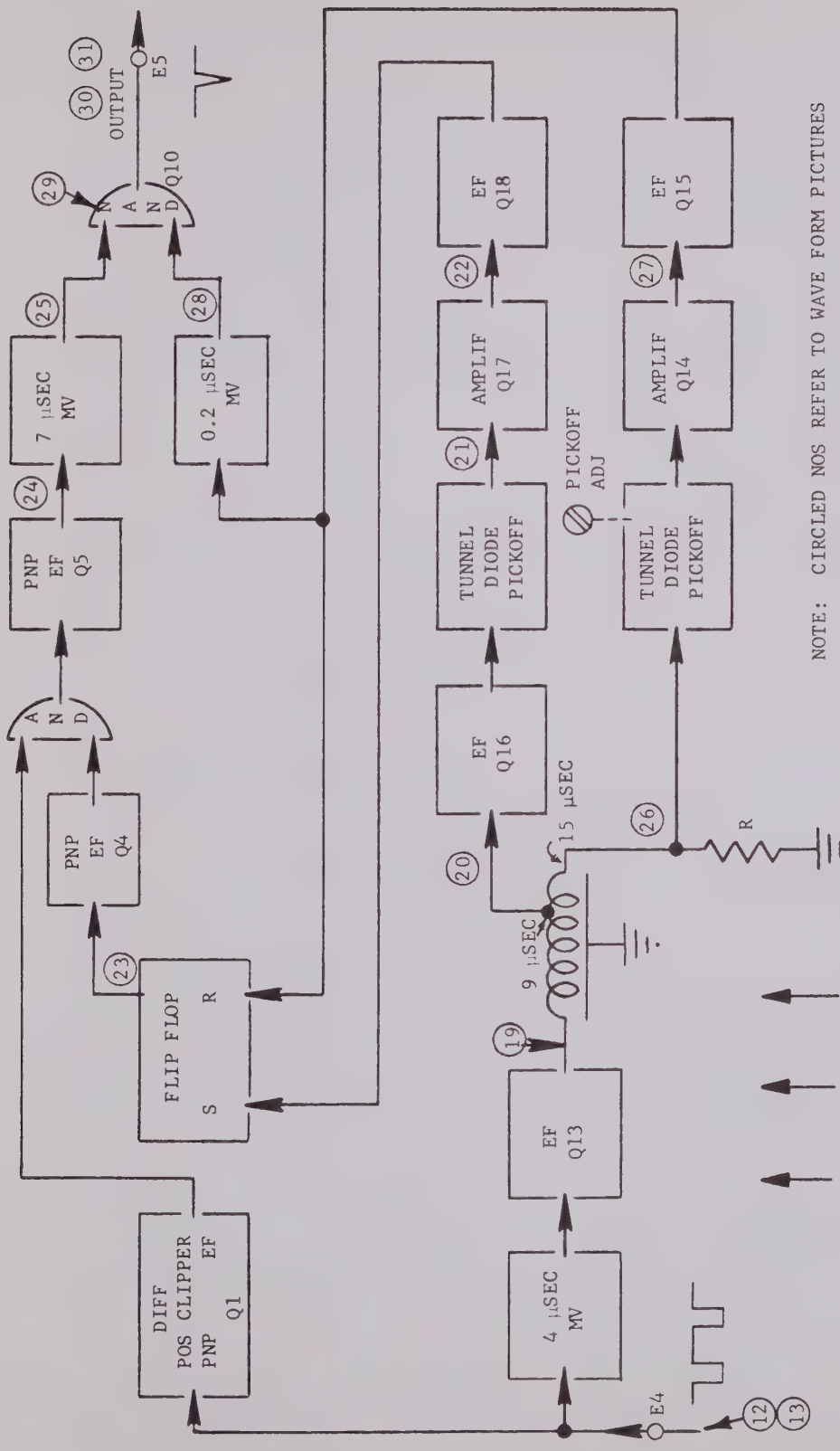


Figure 4-13. Decoder Logic, Block Diagram

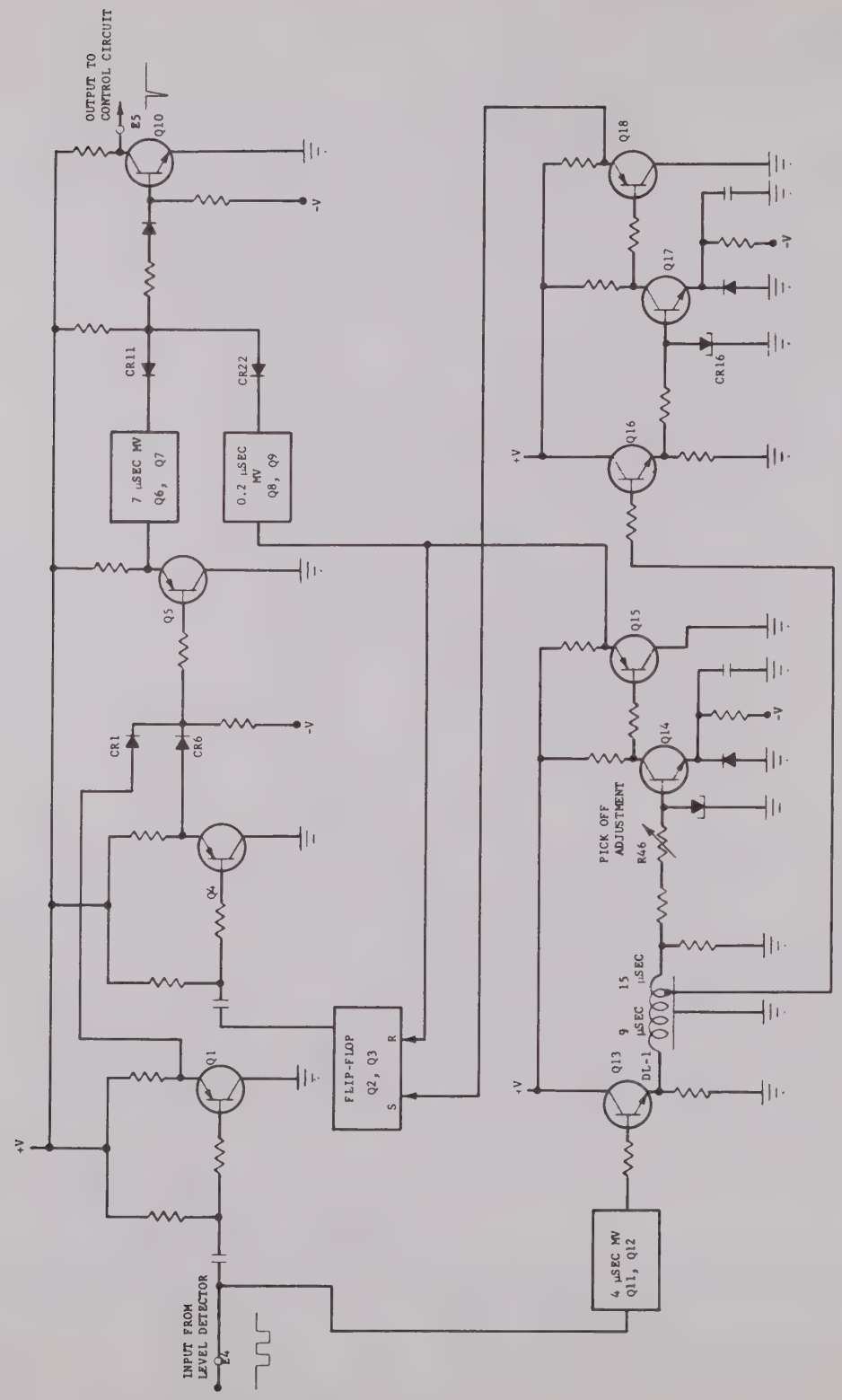


Figure 4-14. Decoder Circuitry, Simplified Schematic Diagram

opening of the NAND gate it will pass and become an output pulse delayed by 15 μsec.

(8) As output pulse a 0.2 μsec shaped pulse is used generated by the multivibrator Q8, Q9. Negative pulses result due to inverter Q10.

(9) A simplified timing chart (Figure 4-15) is presented to clarify the above description. Actual signal pictures under normal operating conditions may be found under the trouble shooting section.

b. ALIGNMENT.-

Pickoff adjust R46 should be adjusted so the tunnel diode fires at 50% point of signal coming from the delay line. Dual trace scope synchronized externally from decoder E4 (neg) will give a superimposed picture showing proper alignment. (Also see Picture 26 in the waveforms at the end of this section)

c. TROUBLE SHOOTING.- (Figures 4-13, 4-14, and 4-15)

(1) For trouble shooting purposes, a set of waveform pictures, taken under normal operating conditions (after proper alignment) is included at the end of this section. (Figures 4-35 through 4-54) The encircled numbers in the schematic and block diagrams refer to signal point and picture numbers. A summary of the waveform photographs is presented in Table 4-1 at the end of this section. (Pictures 19 through 31)

(2) Signals at the input regardless of pulse spacing trigger the 4 μsec MV, enter delay line, are picked off at the 9 and 15 μsec taps to set and reset the flip-flop, thereby opening and closing the AND gate.

(3) If input pulse spacing is within the 9 - 15 μsec window, the 7 μsec MV will be triggered and output pulse produced via the NAND gate.

(4) Any failure should be traced to the point where signal is lost, and followed by examination of the parts in that vicinity.

4-7. AUTOMATIC REPETITION RATE CONTROL (ARRC) CIRCUIT.-(Figures 4-16 and 5-48)

a. FUNCTIONAL DESCRIPTION.-

(1) If the receiver is jammed by a CW signal, or failure of the receiver occurs, the transponder set will continue to transmit 15-Hz bearing information. In this particular case, the transmitter is not triggered by pulses whose origin is receiver noise or interrogation of an aircraft but instead is triggered by random noise pulses generated from a separate source (ARRC) that is independent of receiver noise.

(2) The silicon noise diode CR1, biased by resistor R3 generates white noise. Emitter follower Q1 decouples the noise source from the following three stage amplifier. Shunt diodes CR1 and CR2 attentuate the noise signal if properly forward biased. The amplified noise signal if applied to the tunnel diode pick-off circuitry, CR4, Q5, and emitter follower Q6 drives a 4 μsec one shot multivibrator. The multivibrator turns on and off the transistor switch Q13 which in turn varies the charge voltage of the capacitor C23 in accordance with the die number of pulses (analog counter). This voltage is applied to the base of transistor Q10 (1) of differential amplifier Q10. An adjustable reference voltage (R47) is fed to transistor Q10 (2). Differential amplifier Q10 operates as a voltage comparator. Cross coupling transistor Q9 provides the forward bias currents for the attentuator diodes CR2 and CR3.

(3) Under normal operating conditions the squitter pulses including interrogations are supplied by the receiver, detected by the level detector, decoded by the decoder, and fed to terminal E6 of the ARRC circuit. These

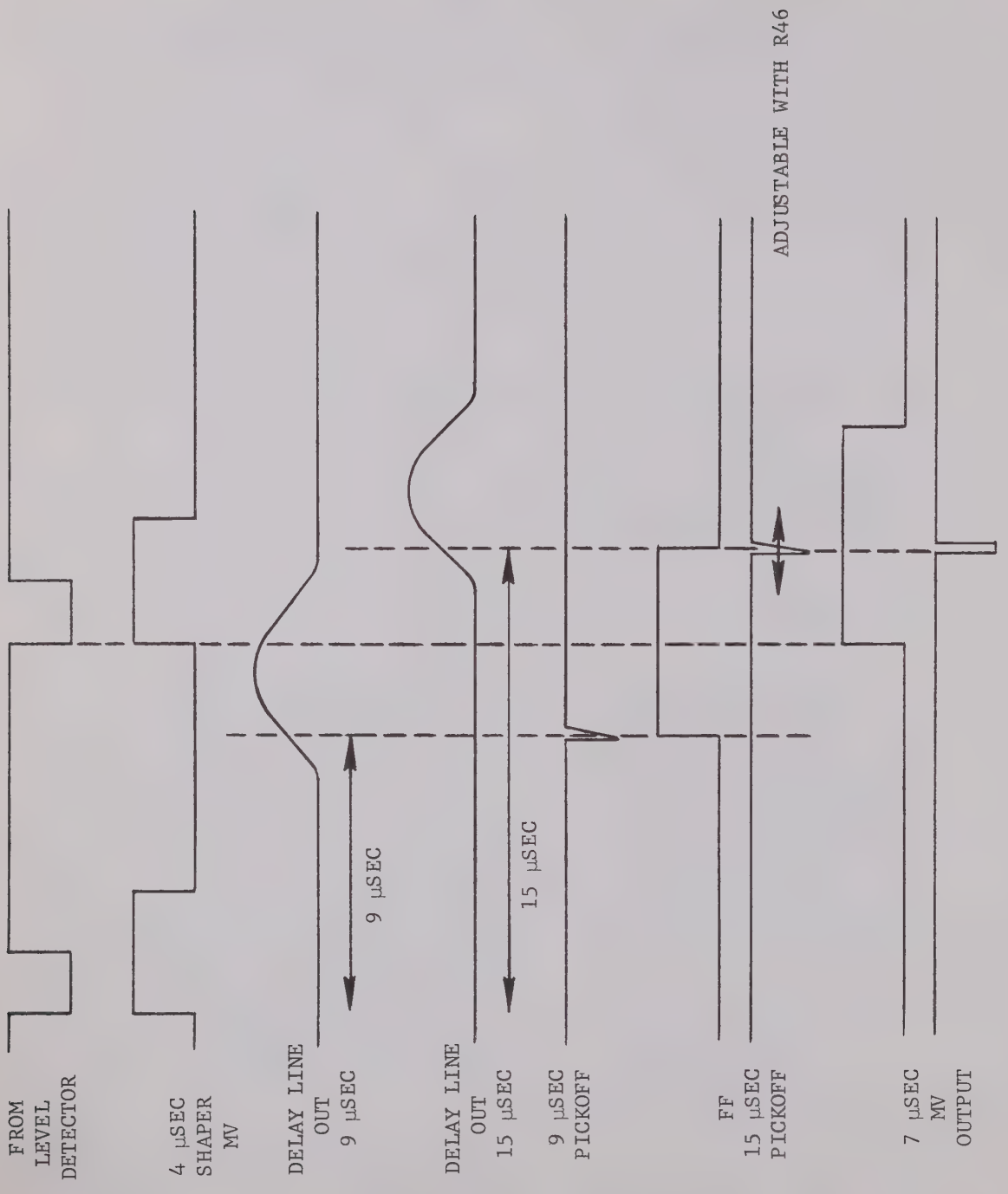


Figure 4-15. Decoder, Timing Chart

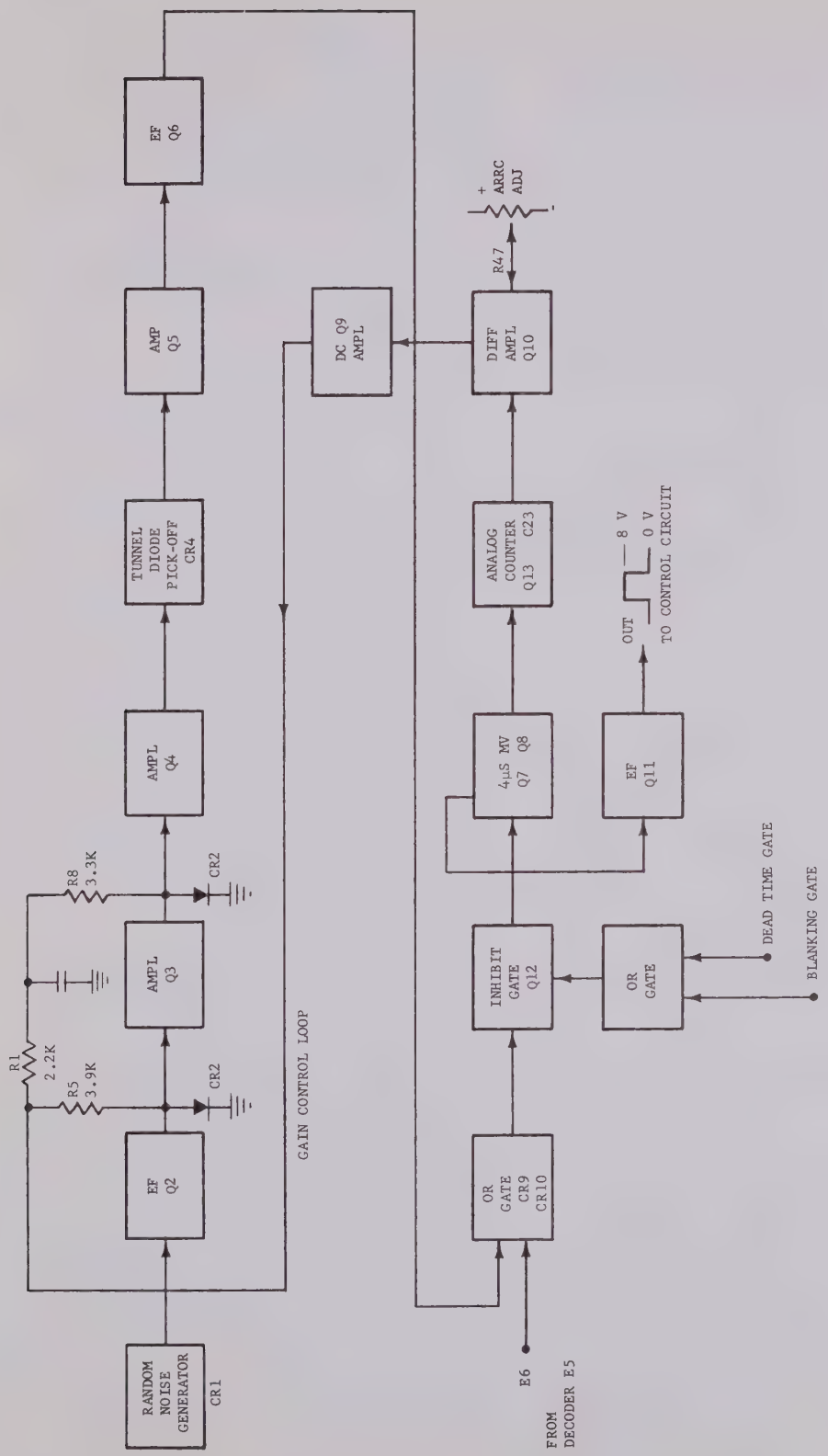


Figure 4-16. ARRC Circuit, Functional Block Diagram

pulses trigger the 4 μsec one-shot multivibrator Q7, Q8. The output emitter follower decouples the load from the multivibrator. The contribution of pulses by the ARRC circuit to the total number of squitter pulses is negligible. But, if the receiver fails to supply the proper number of pulses, the ARRC circuit will supply (partially or totally) all pulses.

(4) The proper number of pulses, 1350 pps, is adjustable by means of R47 on board 1A2A1A1A3 when the receiver is disabled. (Figure 5-6)

(5) Deadtime pulses and blanking pulses are applied through an or-gate to the inhibit gate. Blanking pulses trigger the inhibit gate circuit during transmission and deadtime pulses inhibit the inhibit gate during the deadtime after transmission.

b. ALIGNMENT.-

Set MODE SWITCH into TUNE position and PRIMARY POWER ANT to OFF. Disable receiver by grounding terminal E6 on board 1A2A1A1 with a clip lead. Ground clip lead first before connecting it to terminal E6. Connect counter (capable of counting 10 MHz) to terminal E5 board 1A2A1A3 or E6 board 1A2A1A. Adjust variable resistor R47 for an average reading of 1300 pps on counter (set counter to 10 seconds measuring time). The ARRC circuit is aligned.

c. TROUBLE SHOOTING.- (Figure 4-16, and 5-48)

(1) Make the connections as outlined in the previous paragraph and check alignment. If no reading on the counter can be obtained check the amplifier stages (Q1 to Q4) and compare the waveform with the references waveform (See Table 4-1, Figure 4-42). Disconnect counter if necessary to avoid distortion of the waveform. The monostable multivibrator, Q7, Q8, should be triggered by each noise pulse which exceeds the threshold level of the tunnel diode CR4 after the deadtime has been elapsed (generally 60 μsec). If the tunnel diode CR4 does not fire, check CR4 and the preceding amplifier stages. It might be necessary to interrupt the feedback loop by disconnecting the collector lead of transistor Q9 to locate the faulty stage or component, respectively.

(2) After repair, align the ARRC circuit as outlined in the preceding paragraph.

4-8. CONTROL SECTION.

a. FUNCTIONAL DESCRIPTION.- (Figures 4-17, 4-18, 4-19, and 5-49)

(1) The control section processes the interrogation and/or squitter pulses coming from the ARRC circuit and provides the biggest part of the overall interrogation - reply delay. This function is supplemented with the creation of a dead-time gate for echo suppression so no additional pulses will be processed for a period adjustable over the range of 20 - 65 μsec with R83 and by adding C34 over the range approximately 65 - 210 μsec. The latter can be done by jumping E19 and E20 on board No. 3. In addition to the above, the circuit also generates, when properly triggered, a north burst with associated pre- and post gating.

(2) Input signals from the ARRC circuit are via OR gate 1 and emitter follower Q22 applied to the delay line. After, 27 μsec output pulses are generated by a tunnel diode pick-off circuit and applied to the modulator circuit for encoding via emitter follower Q3. The same input pulse triggers, via OR gate 5 and emitter follower Q23 the 20 - 65 μsec suppression multivibrator Q24, Q25. The output is applied to the ARRC circuit via OR gate 4 to block any pulses for a duration of 20 - 65 μsec. Nominal setting for this multivibrator is 56 μsec. Pulses picked off at the 27.5 μsec tap of the delay line are blocked since AND gate 2 has not been activated.

(3) Generation of a north

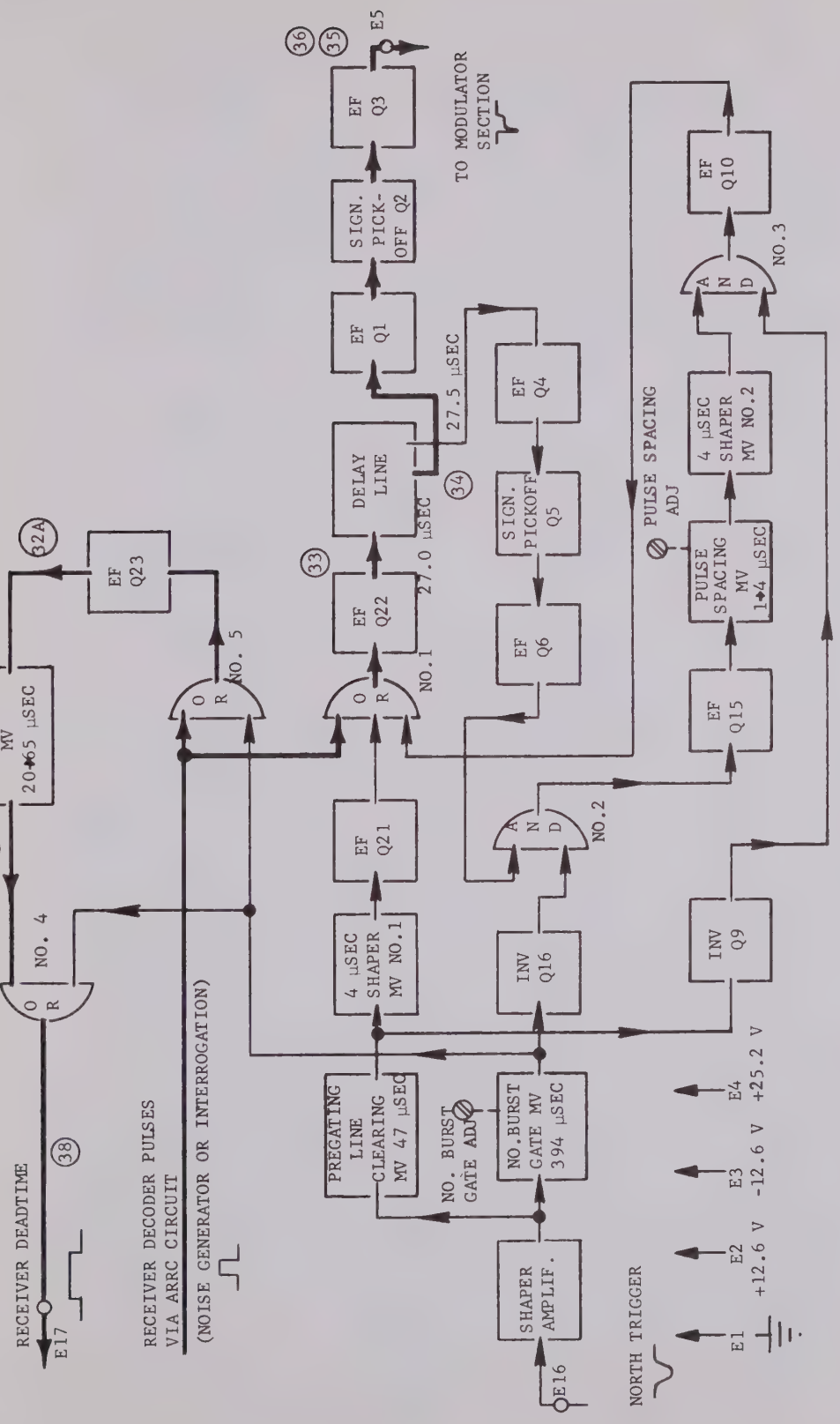


Figure 4-17. Squitter Interrogation Pulse, Control Section Signal Flow Block Diagram

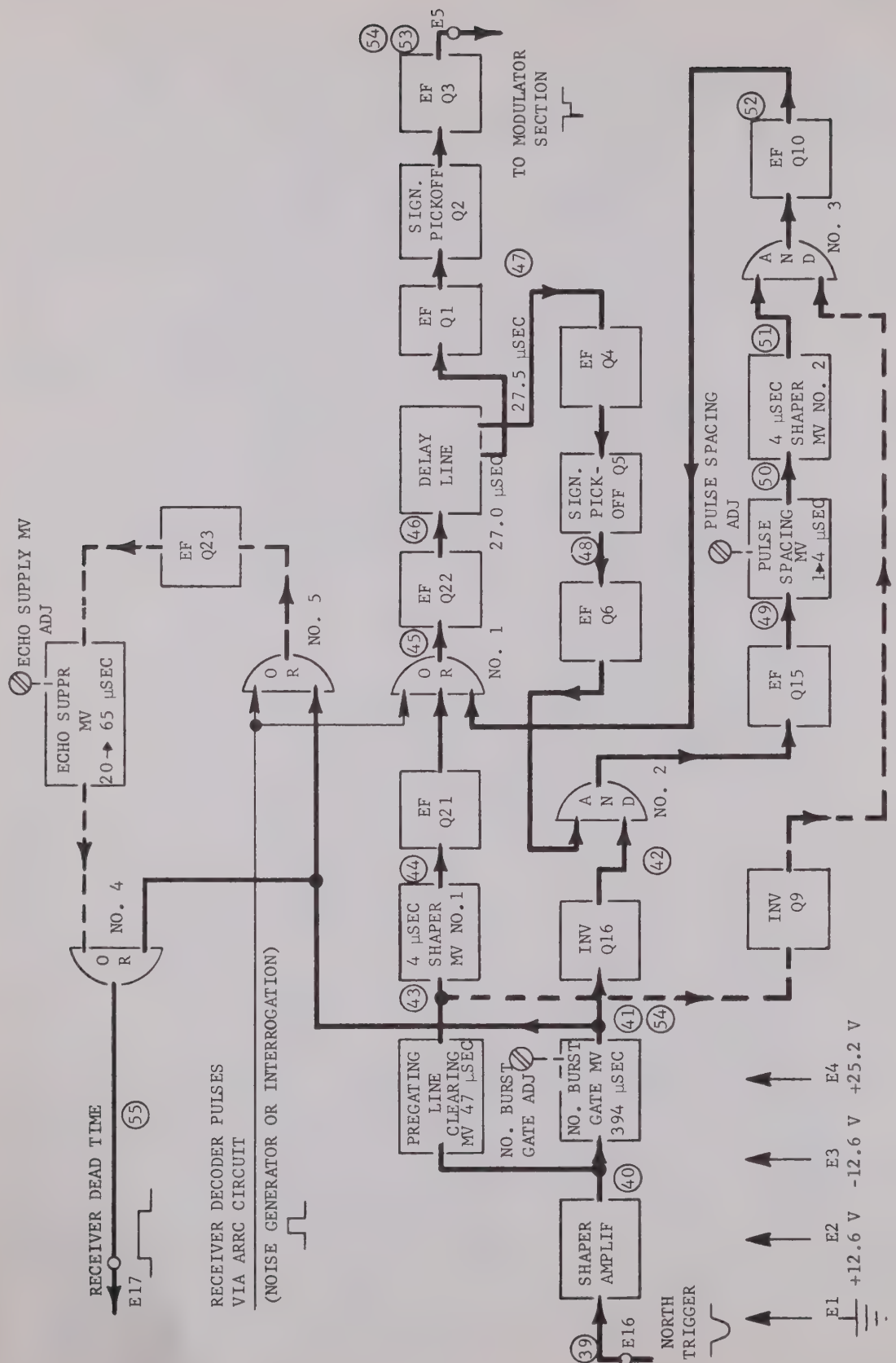


Figure 4-18. North Burst Generation, Control Section Signal Flow Block Diagram

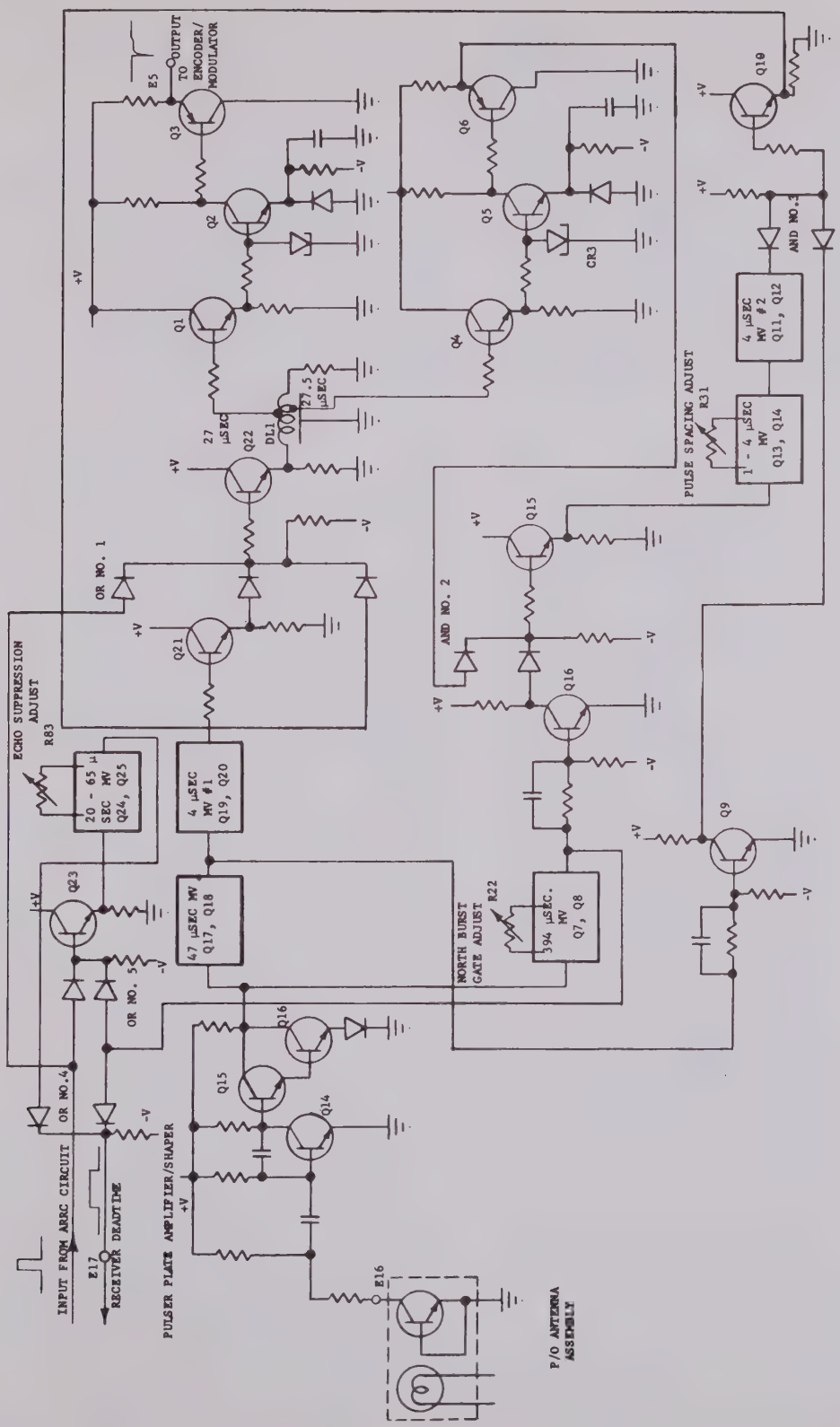


Figure 4-19. Control Circuitry, Simplified Schematic Diagram

burst is accomplished when the negative-going pulse from the antenna pulser plate is shaped in pulser plate amplifier Q14, 15 and 16. The resulting output triggers the 47 μsec pregating and line clearing multivibrator Q17, Q18 plus the 394 μsec north burst gating multivibrator Q7, Q8. The output of the latter activates AND gate 2 via inverter Q16. This however still does not close the so called ring-around loop because AND gate 3 is deactivated for a duration of 47 μsec via inverter Q9. The gating multivibrator also blocks input signals from the ARRC circuit.

(4) After 47 μsec shaper MV No..1 is triggered and the resulting pulse is fed into the delay line via emitter follower Q21, OR gate 1 and emitter follower Q22; 27 μsec later this signal is converted into the first north burst output pulse. Reset of the 47 μsec multivibrator also opens AND gate 3. We now have a closed loop: delay line out at 27.5 μsec; emitter follower Q4; pick-off circuitry CR3, Q5, Q6; AND gate 2; emitter follower Q15; pulse spacing multivibrator Q13, Q14; 4 μsec shaper multivibrator No. 2 Q11, Q12; AND gate 3; emitter follower Q10; OR gate 1; emitter follower Q22 and back into the delay line. This ring-around process will continue until the loop is opened. This occurs after 394 μsec at which time AND gate 3 is deactivated.

(5) The trailing edge of the north burst gating multivibrator triggers the Echo-Suppression multivibrator thereby creating postgating which delays the processing of pulses from the ARRC circuit.

(6) A total of 12 pulses are generated this way with a spacing of 30 μsec adjustable with the 1 - 4 μsec pulse spacing multivibrator.

(7) A simplified timing chart (Figure 4-20) is presented to clarify the above description. Actual signal pictures under normal operating conditions may be found under trouble shooting.

b. ALIGNMENT.-

(1) North burst pulse spacing is: Ground E4 on ARRC board No. 3 and E6 on level detector board No. 1. The output of the control section consist now only of north burst pulses. With 10 MHz counter in period measurement position count interval at E5 (control board No. 4) and set to 30.0 μsec with R31. Pulses at E5 are negative going.

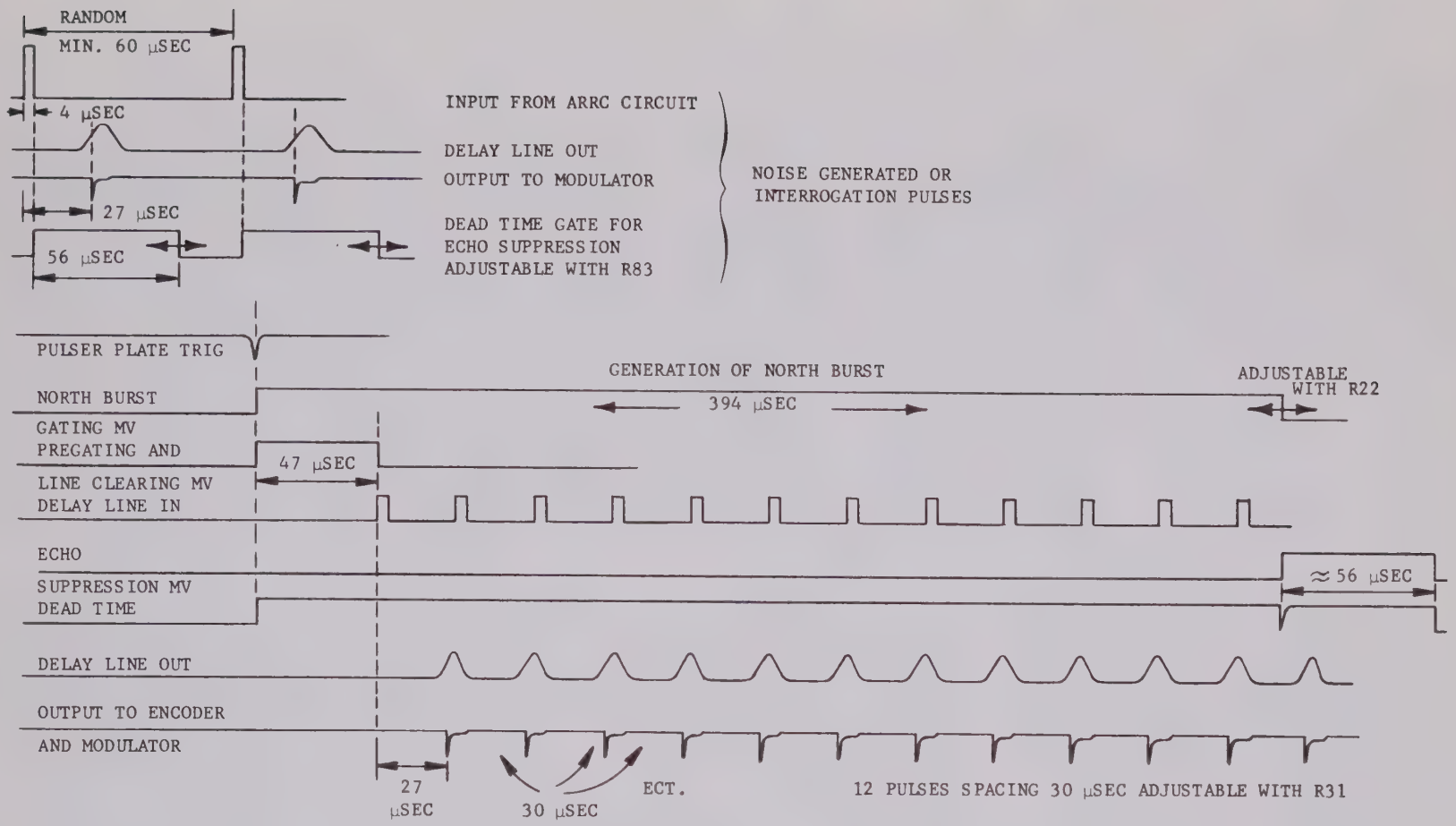
(2) North burst gating MV adjust: Ground E4 on ARRC board No. 3 and E6 on level detector board No. 1. Use dual trace oscilloscope with positive sync. from E14 board No. 3 or E11 board No. 4. For viewing, connect scope to E5 (board No. 4) and E11 (board No. 4). Observe 12 pulses on trace 1 and gating multivibrator output on trace 2. Set R22 so that the trailing edge of gating MV output signal is halfway between 11th and 12th pulse of north burst (Figure 4-47).

(3) Echo suppressing MV adjust: Remove ground from E4 (board No. 3) and E6 (board No. 1). With scope internal sync. (+) look at E17 board No. 3 at output of Echo-Suppression MV and set dead-time to 56 μsec with R83.

c. TROUBLE SHOOTING.- (Figures 4-17, 4-18, 4-19 and 5-49)

(1) For trouble shooting purposes a set of waveform pictures, taken under normal operating conditions (after proper alignment) is included at the end of this section. (Figures 4-33 through 4-54) The encircled numbers in the schematic and block diagrams refer to signal point and picture numbers. A summary of the waveform photographs is presented in Table 4-1 at the end of this section. (Pictures 32A through 55)

(2) The circuit performs two functions: a) Processes squitter



NOTE: IN ADDITION TO RECEIVER DEAD TIMES AS SHOWN, PROVISIONS ARE MADE TO INHIBIT RECEIVER DURING ACTUAL TRANSMISSION OF EACH INDIVIDUAL PULSE WITH A BLANKING GATE

Figure 4-20. Control Section, Timing Chart

and interrogation pulses from the ARRC section to the modulator section and provides receiver dead-time. Refer to signal flow block diagram, Figure 4-17 . b) Generates a north burst with proper pre- and postgating. Refer to signal flow block diagram, Figure 4-18.

(3) In case No. 1 the signal flow is direct and any problem should be easily recognized when tracing signal path with the aid of waveform pictures. Any failure should be traced to the point where signal is lost, and followed by examination of the parts in that vicinity.

(4) In case No. 2 signal flow is somewhat more complicated due to some feedback. Generation of the north burst takes place due to a ring-around condition that exists for a period of 394 μsec. Again, however, with the aid of the signal pictures trouble shooting becomes easy. A failure in the ring-around circuit will result in only one pulse at the output, (15 times per second), since this pulse is generated by the shaper MV No. 1. The remaining 11 pulses are generated by shaper MV No. 2.

(5) The overall output from the dead-time circuit consist of the 394 μsec output plus the 56 μsec echo-suppression MV output. Conditions during observation of waveforms should be carefully duplicated compared to notes supplied with the pictures.

4-9. ENCODER AND MODULATOR.- (Figures 4-21, 4-22, and 5-50.

a. FUNCTIONAL DESCRIPTION

(1) Incoming pulses from the Control Section are delayed in the overall delay MV Q1, Q2 to allow fine setting of the overall 50 μsec delay. The negative trailing edge is differentiated to become the first trigger pulse of an encoded pair. Simultaneously the 12.0 μsec pulse spacing MV Q3, Q4 is triggered--its output differentiated to become the second trigger pulse.

(2) Via OR circuit CR1, CR6 and emitter follower (EF) Q5, the pulses trigger the Gaussian width MV Q11, Q12. The output of the MV is fed into a Gaussian filter via EF Q13. The resulting Gaussian output pulse is applied to a summing network via EF Q14.

(3) The trigger pulse-pair from EF Q5 also trigger a 1 μsec pedestal delay MV Q16, Q17 which in turn triggers the pedestal MV Q18, Q19. The output of the latter is via EF Q20 also applied to the summing network. The resultant pedestal plus Gaussian waveform is, via isolation EF Q15, amplified by Q7, and via EF's Q8 and Q9, applied to the cathode of the r-f tubes to be modulated.

(4) To allow for filament warm-up before modulating the tubes, the amplifier is inhibited by Q6 for a 10 sec period which is generated in the unijunction delay circuit, Q10. After 10 sec the SCR CR8 fires and cuts off Q6.

(5) The output of the pedestal MV is also processed in the gate driving circuitry consisting of inverter Q21, PNP inverter Q22 and EF Q23. The resulting signal is a zero to 25 V pulse-pair--used to gate on the multiplier chain and blank the receiver and ARRC output during transmission.

(6) The pulse spacing can be accurately set with the Pulse Spacing Adjust R5.

(7) The width of the Gaussian pulse can be adjusted with R33.

(8) The pedestal width can be adjusted with R53. This signal can be properly centered under the Gaussian pulse with the Pedestal Delay Adjust R50.

(9) The amplitudes of the pedestal and Gaussian pulses are individually adjustable with R68 and R46 (respectively) and the amplitude of the

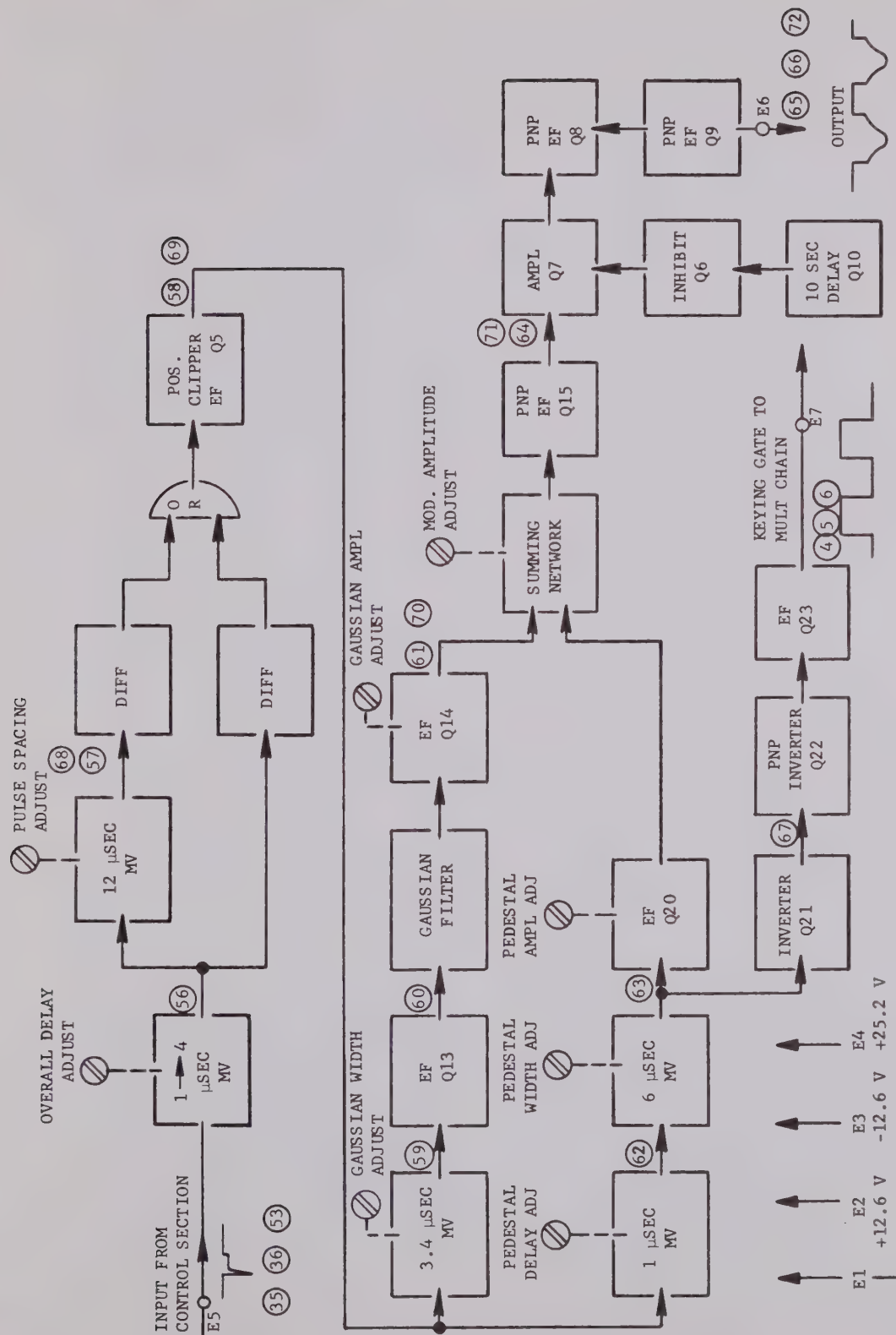


Figure 4-21. Encoder/Modulator, Logic Block Diagram

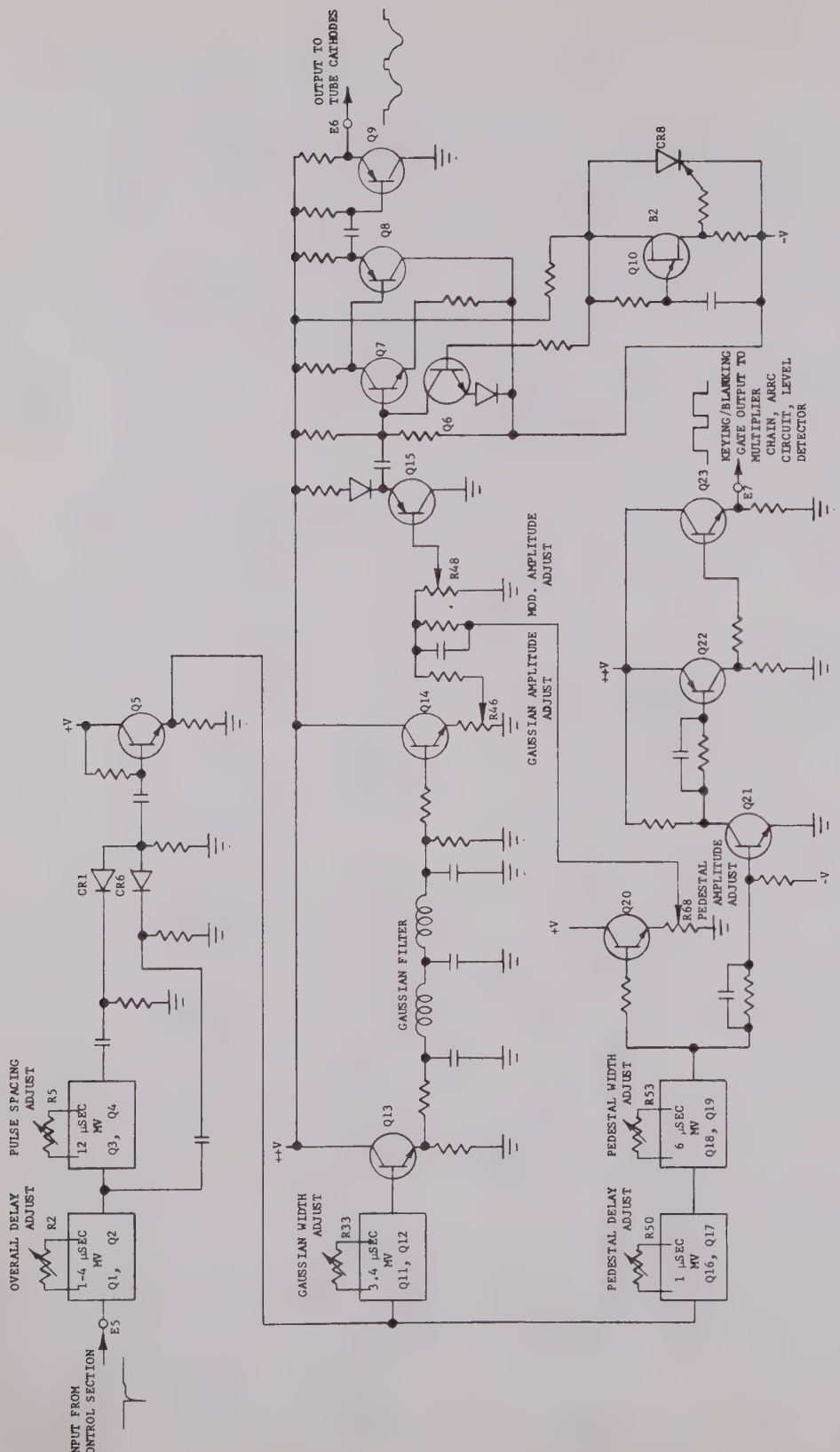


Figure 4-22. Encoder/Modulator Circuitry, Simplified Schematic Diagram

resultant signal with R48.

(10) A simplified timing chart (Figure 4-23) is presented to clarify the above description. Actual signal pictures under normal operating conditions may be found under trouble shooting section.

b. ALIGNMENT.-

(1) Pulse-Pair spacing: Observe gate output at terminal E7 with scope as on Picture 4 (Figure 4-33) and adjust R5 for 12 μsec pulse spacing. These gate pulses coincide in time with the Gaussian output pulses and are easier to align.

(2) Gaussian width: Half amplitude width of the Gaussian pulses at the output of the modulator should be adjusted with R33 to approximately 3.5 μsec. Final adjustment should be made by observing the detected r-f output via directional coupler, 10 db pad, detector, and 50 Ω terminations.

(3) Pedestal width adjust: Gate output at E7 should be adjusted to 6 μsec with R53.

(4) Pedestal delay: By observing the output of the modulator at E6, adjust R50 so Gaussian pulse is properly centered over pedestal. See Picture 65, Figure 4-51 .

(5) Pedestal-, Gaussian-, Modulator-Amplitude Adjust: These adjustments are made by optimizing waveshape and amplitude of the detected r-f pulse at the antenna terminal. The ratio pedestal to Gaussian determines the base width. Excessive overall amplitude causes clipping of the output signal. Adjust for 3.5 ± 0.5 μsec half amplitude width (use 6 db pad for reference), and amplitude at maximum without excessive clipping.

(6) Overall delay adjust: With external triggering from signal generator observe on scope 50% point of first Gaussian pulse and adjust R2 so delay to this 50% point is 50 μsec. For more precise measurements take 6 db pad at output detector, determine peak reference point, remove 6 db pad and ensure that 50% point is equal to reference point. This eliminates errors due to nonlinearity in the detector. Also a marker generator is useful together with expanded sweep display.

c. TROUBLE SHOOTING.- (Figures 4-21, 4-22, and 5-50)

(1) For trouble shooting purposes a set of waveform pictures, taken under normal operating conditions (after proper alignment) is included at the end of this section. (Figures 4-33 through 4-54) The encircled numbers in the schematic and block diagrams refer to signal point and picture numbers. A summary of the waveform photographs is presented in Table 4-1 at the end of this section. (Pictures 56 through 72)

(2) Signal flow is direct up to the point where the trigger pulse-pairs are generated (Q5). From this point on, the signal is split into the Gaussian pulse generator and the pedestal generator. The signals are combined again at Q15--while the pedestal signal is further shaped and processed to become the keying gate output.

(3) The "summed" signal is amplified and applied to the tubes unless inhibited for 10 sec--which is the case after turn-on. High voltage at base 2 of the unijunction transistor indicates that CR8 has not been fired. This prevents amplification of the Gaussian plus pedestal signal.

(4) The various signals are easily followed with the aid of the waveform pictures. Any failure should be traced to the point where the signal is lost, and followed by examination of the parts in that vicinity.

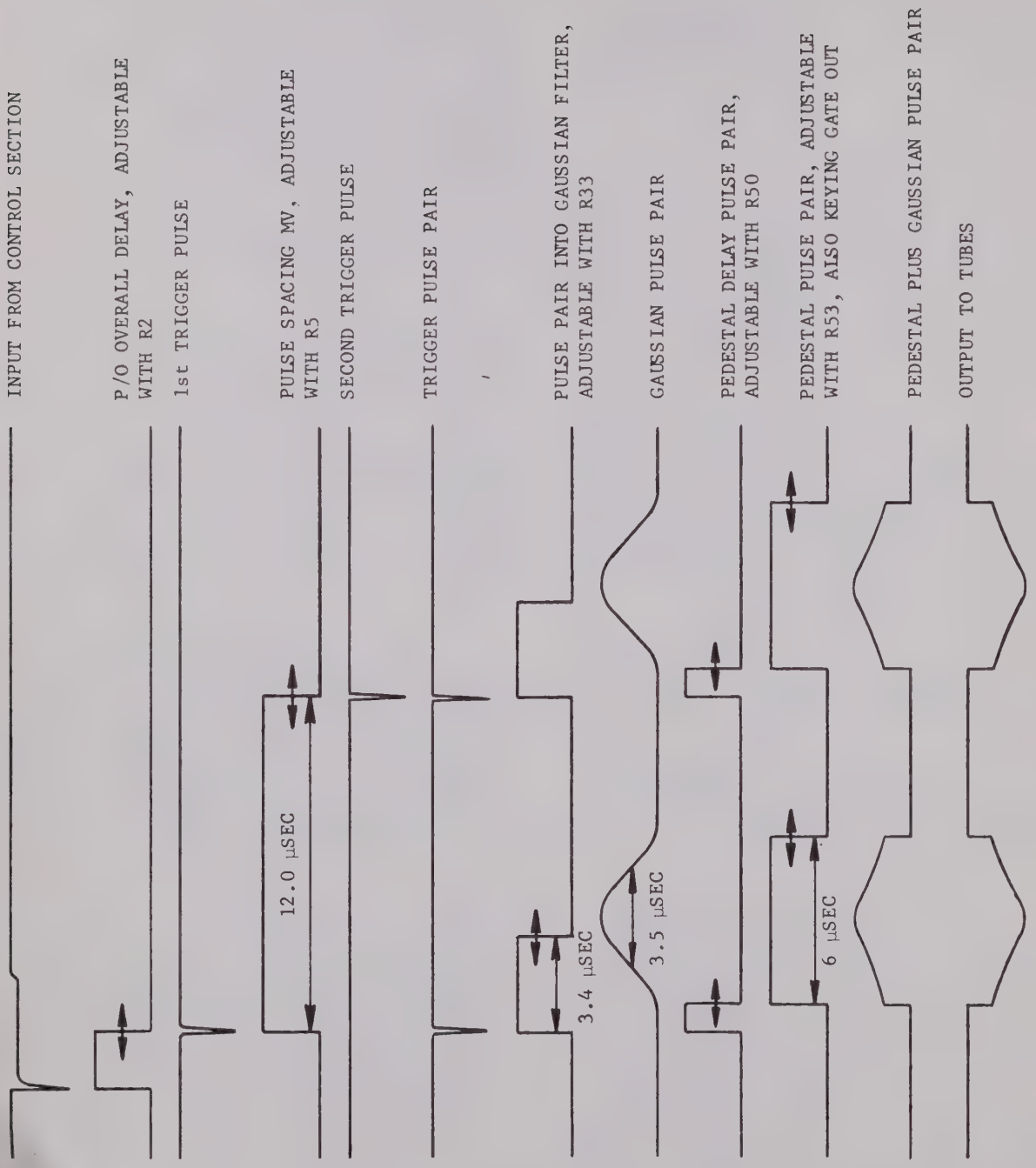


Figure 4-23. Encoder/Modulator, Timing Chart

4-10. CRYSTAL CONTROLLED OSCILLATOR.

a. FUNCTIONAL DESCRIPTION.- (Figure 4-24, 4-25, and 5-51)

(1) The crystal controlled oscillator generates the fundamental radio frequency signal from which the transmitter carrier and the local oscillator frequency are derived.

(2) Transistor Q1 and its associated circuit is a Colpits type oscillator. It generates a signal at the crystal frequency from 40.083333 MHz to 43.321429 MHz which is in turn amplified by two succeeding amplifier stages. Capacitor C14, a front panel adjustment, is used to tune the oscillator circuit and is adjusted for a peak on the test meter in position "OSC" of the test switch.

(3) The signal from the oscillator is coupled through a network, R7 and R12, to the base of the first amplifier, transistor Q2. The collector circuit is tuned by inductor L7 and capacitors C9, C12. Capacitor C12 is factory-aligned.

(4) The final amplifier stage Q3, operates in class C mode. The tuning capacitors in the collector circuit of Q3 are factory-adjusted.

(5) The amplifier stages, Q2 and Q3, are broad-band amplifiers. This permits the operator to change channels without tuning the amplifiers. Detector diode CR1 supplies a DC signal to the test meter for tuning the oscillator stage.

b. ALIGNMENT.-

The crystal controlled oscillator must be tuned (C15) for each crystal individually when frequence channel is changed as described in Section 3, Paragraph 3-4d(10). After repair it might become necessary to retune trimmer capacitors C12 and C13 (Figure 5-29). These capacitors are peak tuned for a crystal frequency in the center of the band (about 41.6 MHz).

c. TROUBLE SHOOTING - (Figures 5-51and 5-24)

(1) If the oscillator is suspected of being faulty, place the TESTMETER SWITCH in the OSC position. A positive indication on the meter indicates that the oscillator stage Q1, and the first amplifier stage, Q2, is operating, since the signal for the meter detector (CR1) is taken off between the first (Q2) and second (Q3) amplifier stage. A positive meter indication does not conform that a signal is present at the output (E3), the final amplifier stage (Q4).

(2) Before disassembling the transponder for trouble shooting, plug another crystal into the crystal holder in order to affirm that the crystal now being used is not defective.

(3) If the oscillator is found defective disassemble transponder and chassis as outlined in Section 5. The oscillator circuit is located on the bottom side of the frequency multiplier chain assembly. Remove only the bottom lid. If necessary disconnect all cable connections to the assembly and use external regulated power supplies with properly adjusted and filtered DC voltages.

(4) To locate the faulty component first measure all DC supply voltages and follow the general instructions given in paragraph 4-3. If necessary disconnect the output of the final stage (Q4) from the frequency multiplier chain (E3) and measure the r-f power (crystal frequency). The power should be between +18 and +20 dbm on 50 Ω.

4-11. FREQUENCY MULTIPLIER CHAIN. (Figures 4-26 and 5-52)

a. FUNCTIONAL DESCRIPTION.-

(1) The input to the

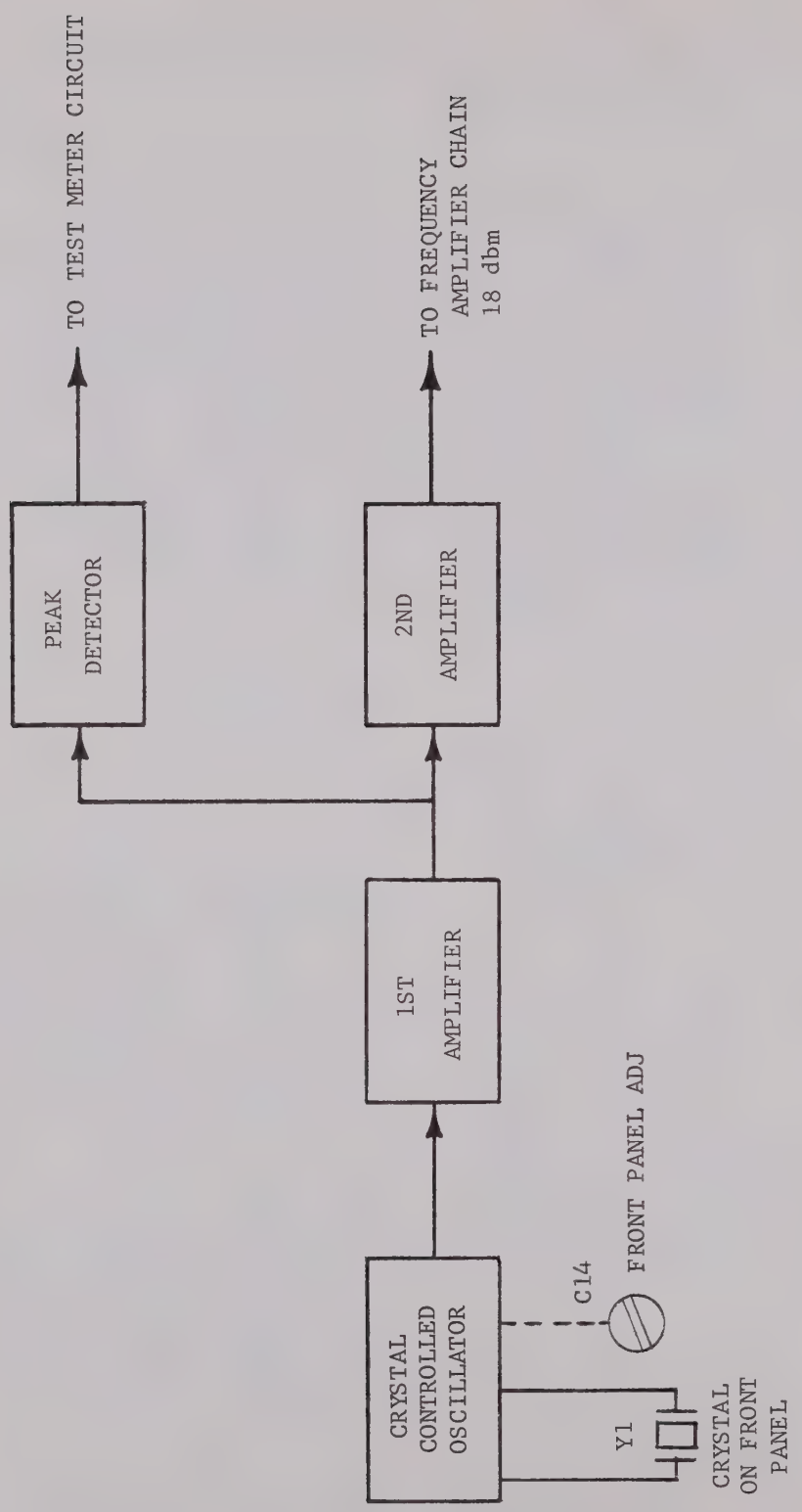


Figure 4-24. Crystal Controlled Oscillator, Functional Block Diagram

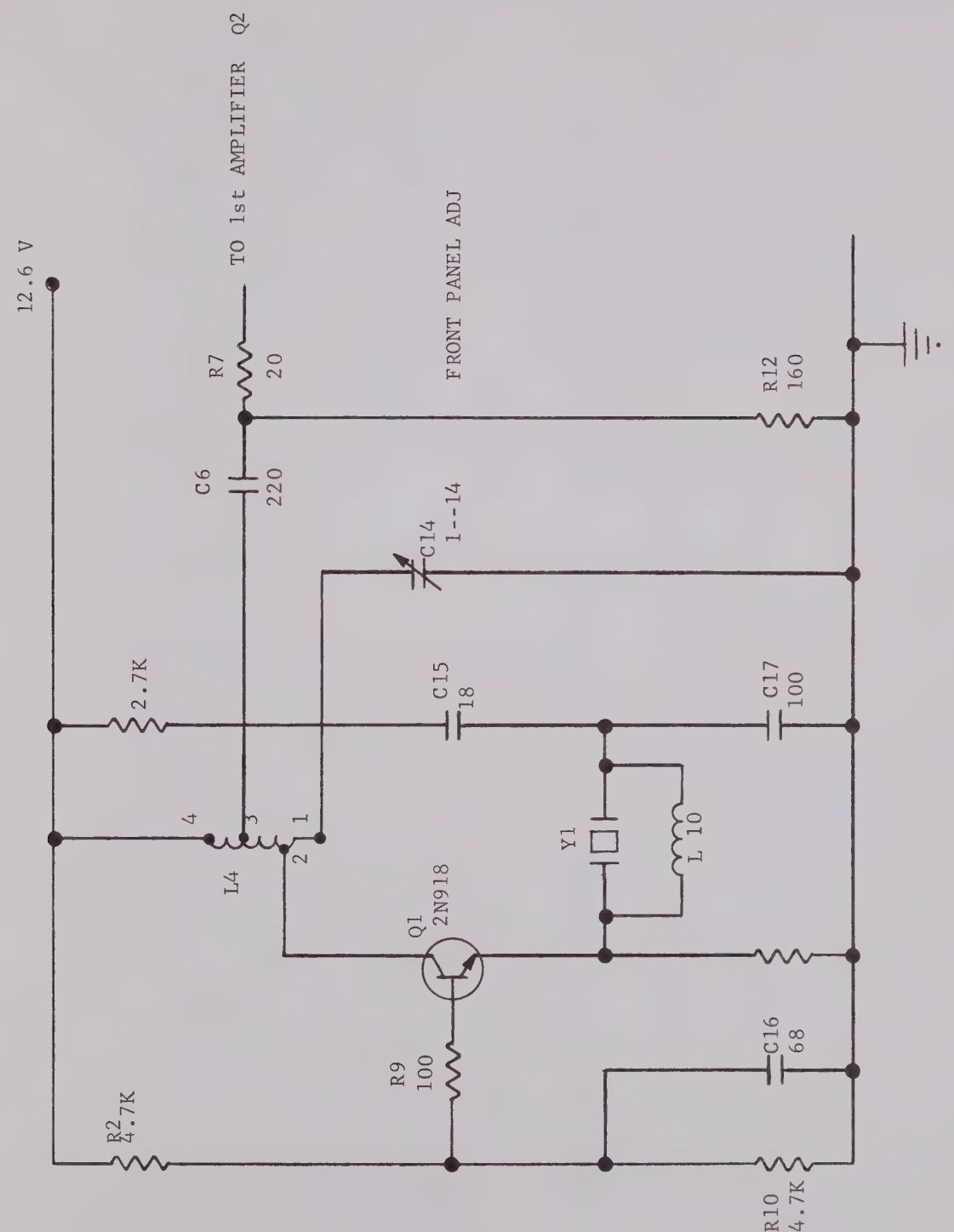


Figure 4-25. Crystal Controlled Oscillator, Simplified Schematic Diagram

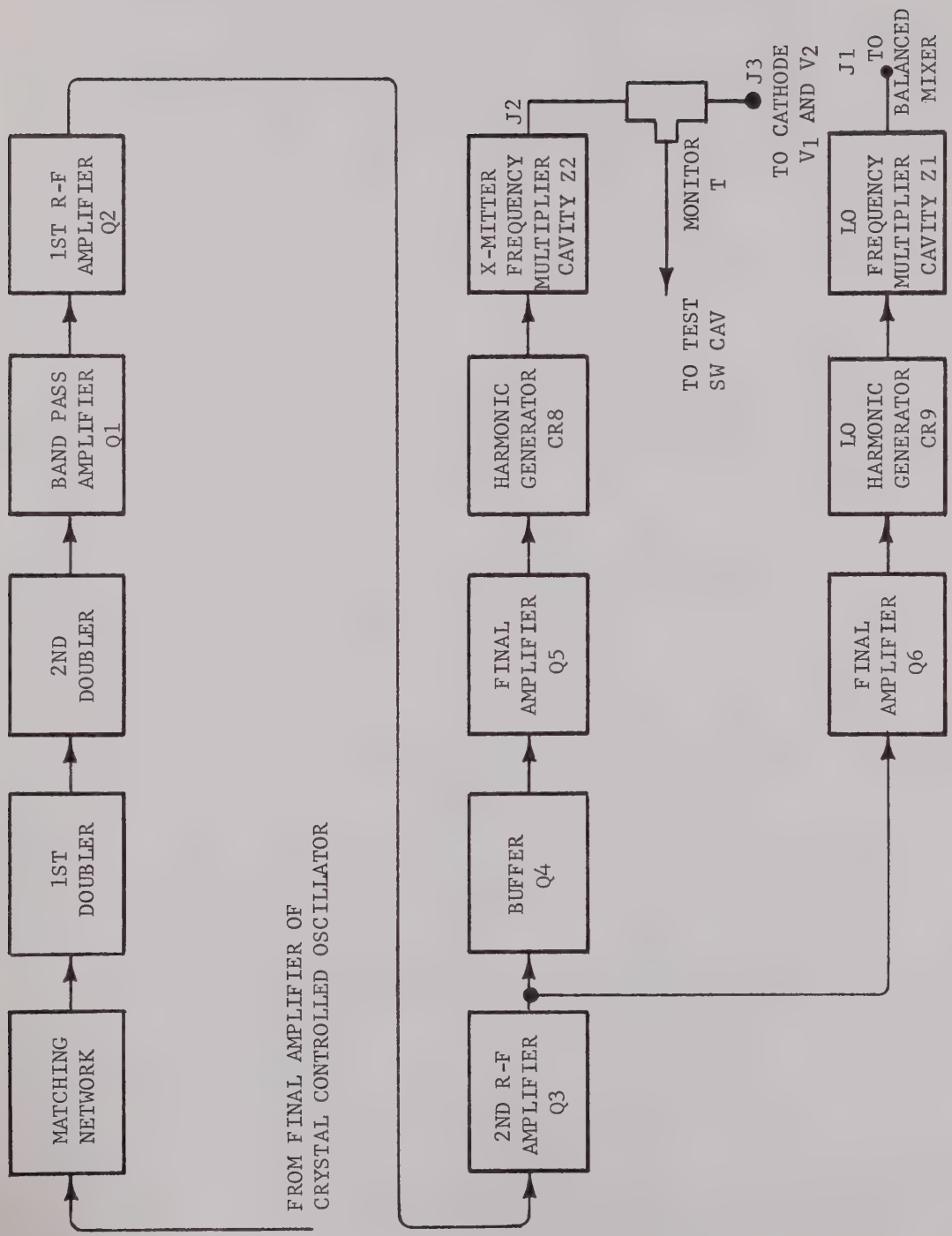


Figure 4-26. Frequency Multiplier Chain, Functional Block Diagram

multiplier chain from the crystal controlled oscillator is a CW signal having a power level of approximately +18 dbm. The frequency of this input signal is between 40.083333 MHz and 43.32143 MHz. A network, consisting of resistors is used to match final amplifier of the crystal controlled oscillator to the input of the multiplier chain. The signal from the oscillator is doubled by the full-wave balanced doubler. This frequency doubled signal is then doubled again by another full-wave balanced doubler. In each doubler, the capacitors resonate the secondary inductances of the transformers, and the r-f chokes provide D-C return paths for the diodes.

(2) From the output of the last doubler, the signal, multiplied by 4 to a frequency of 160 MHz to 173.2 MHz is applied to the band-pass amplifier stage Q1. The band-pass amplifier has an overall gain of 3 db, with roll-off frequencies at 155 MHz and 177 MHz. A ripple of 1 db or less exists over the pass-band.

(3) The filtered signal is next amplified by the two conventional broad band r-f amplifiers Q2 and Q3. These amplifiers use the medium power 2N3137 transistor and provide a gain of 7 db per stage. Transistor Q4 is a Class -C r-f amplifier, temperature compensated by a sensistor. With a power gain of 8 db, the signal at the output of Q4 (Figure 4-27) is approximately ±25 dbm. Tuning adjustment over the frequency band is provided by C14. The final amplifier Q5 is temperature compensated by a sensistor. The output of Q5, is applied to the matching network consisting of capacitors C32, C34, C35, and inductor L23. The matching network converts the impedance level from the output of Q5 down to approximately 1.5Ω to match the step-recovery diode, CR8 which functions as a harmonic generator. When driven by the output power of the matching network, the step-recovery diode CR8 heavily conducts each cycle in the forward direction, generating minority carriers in the vicinity of its junction. When the drive polarity reverses, these minority carriers return to the junction and suddenly recombine. The resulting external current each cycle is a large forward current followed by an even larger reverse current of short duration that is abruptly cut off. The cathode of the diode is coupled to the cavity by means of a probe. The voltage at the top of the diode, rich in higher order harmonics because of the abrupt cut-off of reverse current each cycle, excites these harmonics in the cavity CAV 2. For the lower TACAN band the cavity is tuned to select the 6th harmonic, for the upper band, the 7th.

(4) The signal, now multiplied by six (lower TACAN band, 962-1024 MHz) or by 7 (higher TACAN band, 1151-1213 MHz) and at a level of approximately 23 dbm is coupled from the cavity Z2 by a coupling loop to J2. A sensistor serves as a temperature compensated bias resistance for the step-recovery diode CR8. The meter detector circuit is used for peak-tuning purpose.

(5) A signal of the same frequency is provided for the local oscillator of the receiver by the LO multiplier chain section. The output power of transistor Q3, is coupled to the base of Q6 where it is amplified. The output of Q6 is coupled to another matching network which in turn is coupled to another step-recovery diode CR9 and resonant cavity Z1. The resulting output is coupled from the cavity by a coupling loop at a level of 3 dbm for the receiver local oscillator to J1.

(6) Keying of the final stage, Q5, of the transmitter frequency multiplier chain between pulses of a pair and between pulse-pairs results in low spurious output levels. The r-f output level during the interval between occurence of the desired pulse-pairs and between the pulses of each pulse-pairs is at least 80 db below the maximum power level during transmission.

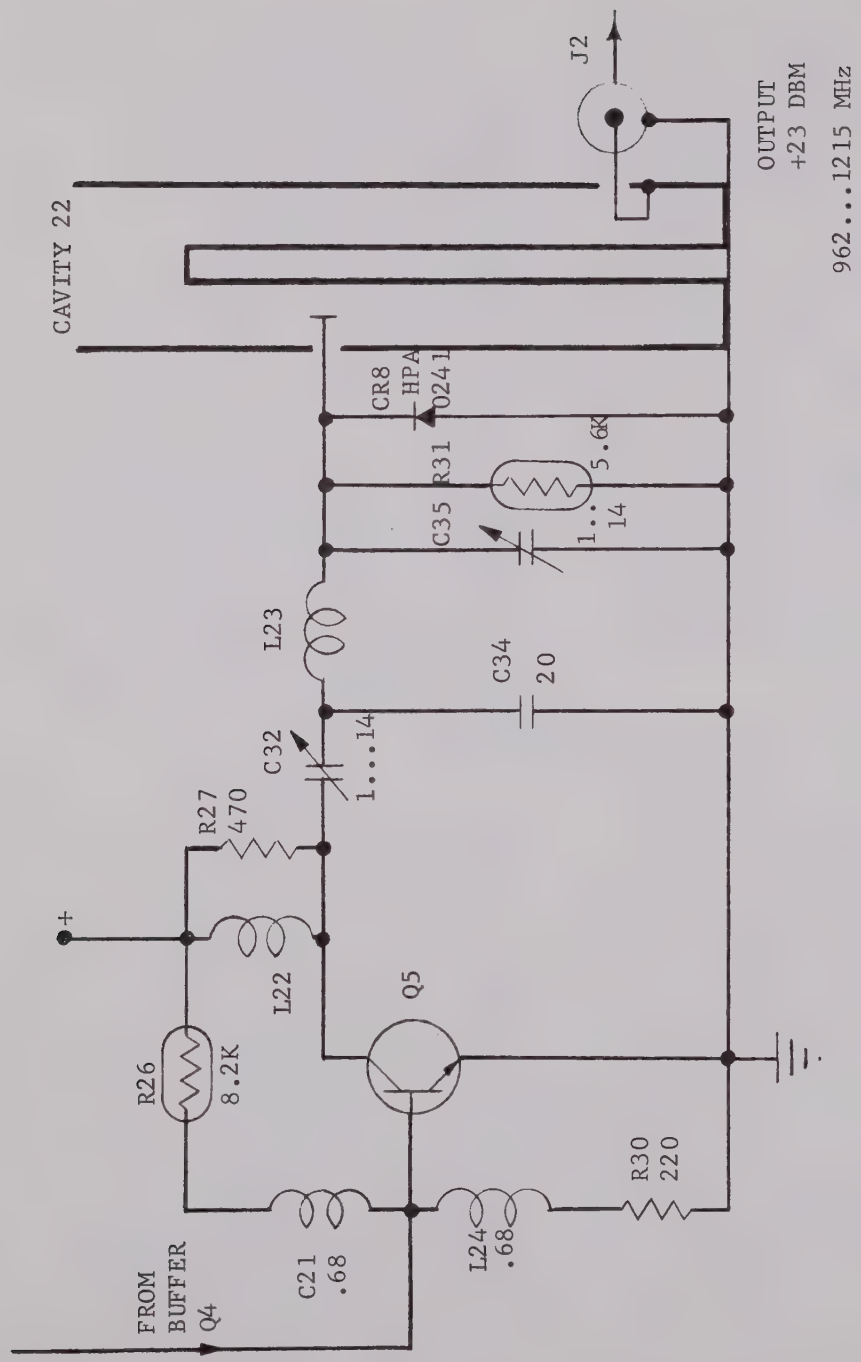


Figure 4-27. Final Stage of the Frequency Multiplier Chain, Simplified Schematic Diagram

(7) When the MODE SW is placed in the TUNE position, the transmitter multiplier chain is operated in CW mode. This is accomplished by applying 25.2 VDC to the final amplifier stage in the chain. CW is required during tuning operations in order to obtain adequate tuning TEST METER current indication.

(8) To prevent transmission during tuning operation the tubes are disconnected from the modulator and biased beyond cut-off. When the MODE SW is placed in the STBY (Stand-by) position, the final stage of the transmitter frequency multiplier chain as well as the tube r-f power amplifier are disabled.

b. ALIGNMENT.-

(1) ALIGNMENT OF QUADRUPLER STAGES.- Disassemble the frequency multiplier chain from the transponder as described in Paragraph 5-3a(3) but do not disconnect any cables. Remove the top lid. Disconnect the crystal controlled oscillator from the input of the frequency multiplier chain at E3 (Figure 5-31) and solder a 10 in. long 50 Ω cable in place of the crystal controlled oscillator connection.

(a) Connect the 41.5 MHz 20 dbm output signal from oscillator TF1247 via the 50 Ω cable to the input of the multiplier chain.

(b) Disconnect the base of transistor Q1 from the junction of R3, R14, and C17 and solder a 50 Ω cable in its place.

(c) Connect the 50 Ω cable to an oscilloscope (HP585) which is capable of displaying a 160 MHz signal.

(d) Adjust capacitors C10, C25, and C19 for a peak on the scope. These three controls interact and so it is necessary to retune each control several times.

(2) ALIGNMENT OF AMPLIFIER STAGES.- Reconnect the circuit at the base of transistor Q1.

(a) Disconnect R10 from the base of transistor Q4 and solder a 50 Ω cable to the open end of R10.

(b) Connect this 50 Ω cable to the "IN" jack of the sweep generator SM-2000 via a video detector and also connect the appropriate output of the sweep generator to the vertical and horizontal drives of the scope.

(c) Connect the signal from the "RF1" jack of the sweep generator to the 50 Ω input cable of the multiplier chain.

(d) Adjust the sweep generator so that a sweep is produced which covers the input frequencies from 40.1 MHz to 43.4 MHz and select markers which will provide identification of this frequency band.

(e) Tune the capacitors C11, C20, C21, C7, C12, C13, and C8 to obtain a band pass in the amplifiers which will pass the frequencies mentioned above. These controls interact and so it is necessary to retune the controls several times to get a flat response across the frequency band.

(f) Remove the two 50 Ω cables and reconnect the circuitry. The multiplier chain is now ready for tuning to the selected channel.

c. TROUBLE SHOOTING.-(Figure 5-52)

(1) TRANSMITTER FREQUENCY MULTIPLIER CHAIN.- The TEST METER on the front panel of the transponder can be used to determine if a catastrophe failure has occurred somewhere between the amplifier stages of the crystal controlled oscillator and the outputs of the frequency multiplier chain. This

condition should be suspected if, with the transponder operating, the test meter switch is in the cavity position and the meter does not show a positive indication. The MODE SWITCH must be in the TUNE position.

(a) If the multiplier chain is disassembled from the transponder assembly (Instruction for disassembly Paragraph 5-3a(3)) but is still electrically connected to the transponder with the top lid removed, three test points (Figure 5-27) are exposed which can be used in trouble shooting.

(b) A negative 0.5 to 1.25 VDC at TP1 (measured with a voltmeter $\geq$ 10,000 Ω per volt) would be an indication that the crystal controlled oscillator and the quadrupler stages of the multiplier chain are working satisfactorily.

(c) A negative 1 volt signal or greater signal at TP2 is an indication that the crystal controlled oscillator and the frequency multiplier chain stages through Q3 are working satisfactorily. If the proper voltage is present at TP1 and not at TP3, this is an indication that the multiplier chain has failed between the last quadrupler stage and Q4.

(d) A negative 0.5 volt or greater signal at TP3 indicates that the multiplier stages through Q4 are working. If the proper voltage is present at TP2 and not at TP3, this is an indication that the buffer amplifier Q4 has failed.

(e) If the proper voltage is present at TP3 and the panel meter does not give an indication with test meter switch in CAV position, it indicates that the final amplifier stage Q5, the cavity coupling circuitry, or the step-recovery diode CR8 has failed.

(f) An r-f power meter should be used for further trouble shooting. The r-f power meter (50 Ω impedance) is to be connected to r-f connector J2 located on the transmitter multiplier chain cavity Z2 to verify the proper r-f output power of +23 dbm.

(2) LO FREQUENCY MULTIPLIER CHAIN.- Since the signal for the LO chain is derived from the third stage of the transmitter chain, trouble shooting in this area, from the crystal controlled oscillator through the multiplier stage Q3 (TP1, TP2), is to be accomplished as described above.

(a) If the transmitter chain works properly, (approximately +23 dbm r-f output at connector J2) but the test meter in LO position shows no positive indicator, the LO chain might be badly detuned or the receiver mixer diodes CR1 and CR2 are defective. For trouble shooting the LO chain, an r-f power meter should be connected to the r-f connector J1 located at the LO cavity Z1. Set the r-f power meter to a more sensitive position and try to carefully retune the LO chain as described in Paragraph 3-4d.

(b) If peak-tuning to +3 dbm ±1 db is not possible, check transistor stage Q6 (remove bottom lid), variable capacitor C43, and step-recovery diode CR9. The step-recovery diode can be tested by means of a curve tracer. This does not yield complete information as to whether the diode is defective or not, but in most cases, when the step-recovery diode shows in principle a characteristic like a silicone diode, the diode is not defective.

Note

The r-f cables at the front end of the receiver, A5J11 - A5J10, A5J1 - A3J2, A4J2 - A3J1, A5J12 - A4J1, should not be changed. When a cable or a connector is defective and is to be replaced, the same electrical cable length as the original cable must be used to insure proper operation.

over the entire frequency band.

4-12. R-F POWER AMPLIFIER. (Figure 4-3)

a. FUNCTIONAL DESCRIPTION.-

(1) The r-f power amplifier consists of three cascaded L-band tube/cavity amplifiers: pre-amplifiers V_1 and V_2 and final amplifier V_3. All tubes are type 4062A pencil triodes. The overall gain of the three stages is approximately 30 db. Each cavity has a frequency tuning dial and lock. Tuning frequencies are shown in Figures 3-15 a and b. Each unit has individual graphs showing frequency versus dial reading.

(2) All three tubes operate in grounded-grid mode. 1000 VDC is supplied by a cable to the end plug choke and is in turn applied via plate line to the plate of the tube. Moving the end plug choke towards the tube the length of the cavity is decreased, consequently the resonant frequency of the cavity increases and vice versa. By rotating the dial shaft of the cavity clockwise the frequency decreases, and by rotating the dial shaft counterclockwise, the frequency increases. The adjustment of the anode coupling probe of the cavities should never be changed when tubes are replaced.

(3) The r-f input signal is coupled via cathode probe to the cathode of the tube V_1. The cathode line and short assembly represents a quarter wave length r-f choke to the r-f input signal.

(4) Pulse-pair amplitude modulation of the microwave signal is accomplished by applying the modulation video signal from the modulator to the inside of the first and second cathode lines (V_1 and V_2) of the three stage r-f power amplifier. This video signal is a composite waveform consisting of a Gaussian pulse on top of a pedestal. Tubes V_1 and V_2, normally cut-off, require the pedestal to bring them from below cut-off stage to the point of conduction. The tubes are driven to full conduction by the Gaussian modulating voltage superimposed upon the pedestal. The result is approximately Caussian modulated r-f pulse-pairs. Tube V_3 operates in class -C mode and does not receive any video modulation pulse.

(5) The final stage V_3 has a small coupling loop which is connected to a video detector diode. The detected r-f output signal is coupled to the r-f monitor circuit (Figure 5-53). The positive going video pulses are amplified by transistor Q15 and fed through capacitor C20 to the base of transistor Q16. The peak detector, consisting of diode CR10, capacitor C19, and resistor R45 supplies a DC signal for tuning purpose to the test meter circuit.

b. ALIGNMENT.-

(1) All plate probes of the tube cavities are factory adjusted and should never be changed. Otherwise, the peak power may be considerably reduced over the frequency bands.

(2) Other adjustments as described in Paragraph 3-4c and d are not necessary.

c. TROUBLE SHOOTING.-

(1) GENERAL.- When the r-f power amplifier fails to function properly, it can be recognized by:

(a) No r-f output power;

(b) Reduced r-f output power;

(c) Only minor or no reduction of r-f power by excessive droop of the north burst;

(d) Excessive loss of r-f power and excessive north burst droop; and,

(e) Arcing during

operation or tuning.

Proper operation for tube V_3 (RCA 4062A) can be expected for about 500 hours operating time and for tubes V_1 and V_2 about 1000 to 1500 hours operating time.

For disassembly and reassembly instructions of the transponder and tube cavities see Paragraph 5-3a(4) and 5-3b.

(2) NO R-F OUTPUT POWER.

(a) Check tuning of the transponder in accordance with Section 3 Paragraph 3-4c and d.

(b) Check setting of the MODE SWITCH (OPER).

(c) Check voltages on test meter (power supply and OSC). If trouble cannot be found remove transponder from the case (described in Section 5) and follow instructions given in Paragraph 4-3 and 5-2b(1).

(d) Check all r-f cable connections and r-f connectors (center pins).

(e) Check to see if the power amplifier V_1 and V_2 receives proper mudulation signal by measuring with an oscilloscope voltage and waveform on R1 and R2. (Figures 4-3, and 4-28) Measure plate voltage (1000 VDC across C1 located on preselector tube assembly.

Warning

Operation of this equipment involves the use of HIGH VOLTAGES which are dangerous to life. Do not change transistors or components inside the transponder case with the power switch ON. Do not depend upon safety interlock switches for protection. Under certain conditions, dangerous potentials exist in the circuit with power controls in the OFF position due to charges retained by capacitors. To avoid shock and severe burns, always discharge and ground circuits before touching them. Never service or adjust the equipment without the presence of the assistance of another person capable of rendering first aid immediately.

(f) Measure filament voltage (6.3 V) on power supply assembly. (Figure 4-29)

(g) Check to see if the transmitter frequency multiplier chain delivers r-f power to the cathode of tube V_1.

(h) Check to see if the transmitter frequency multiplier chain receives a 25 V gate from the modulator. This can be checked at the pins of the MODE SWITCH on the rear of the front panel. (Figure 4-30)

(i) Check and replace tubes.

(3) REDUCED OUTPUT POWER.-

(a) In general improper tuning of the transponder and wrong duplexer cable causes reduced output power.

(b) Check battery voltage.

(c) Check r-f cable and pins of r-f connectors.

(4) MINOR OR NO REDUCTION IN R-F POWER AND EXCESSIVE DROOP.- Replace tube V_3 (eventually V_2 and V_1).

(5) LOW R-F POWER AND EXCESSIVE DROOP.- Replace tube V_3 (eventually V_2 and V_1).

(6) ARCING.- If arcing is inside the tube cavities, disassemble cavities and inspect all parts inside the cavities. If necessary, replace teflon tape. Do not change setting of an

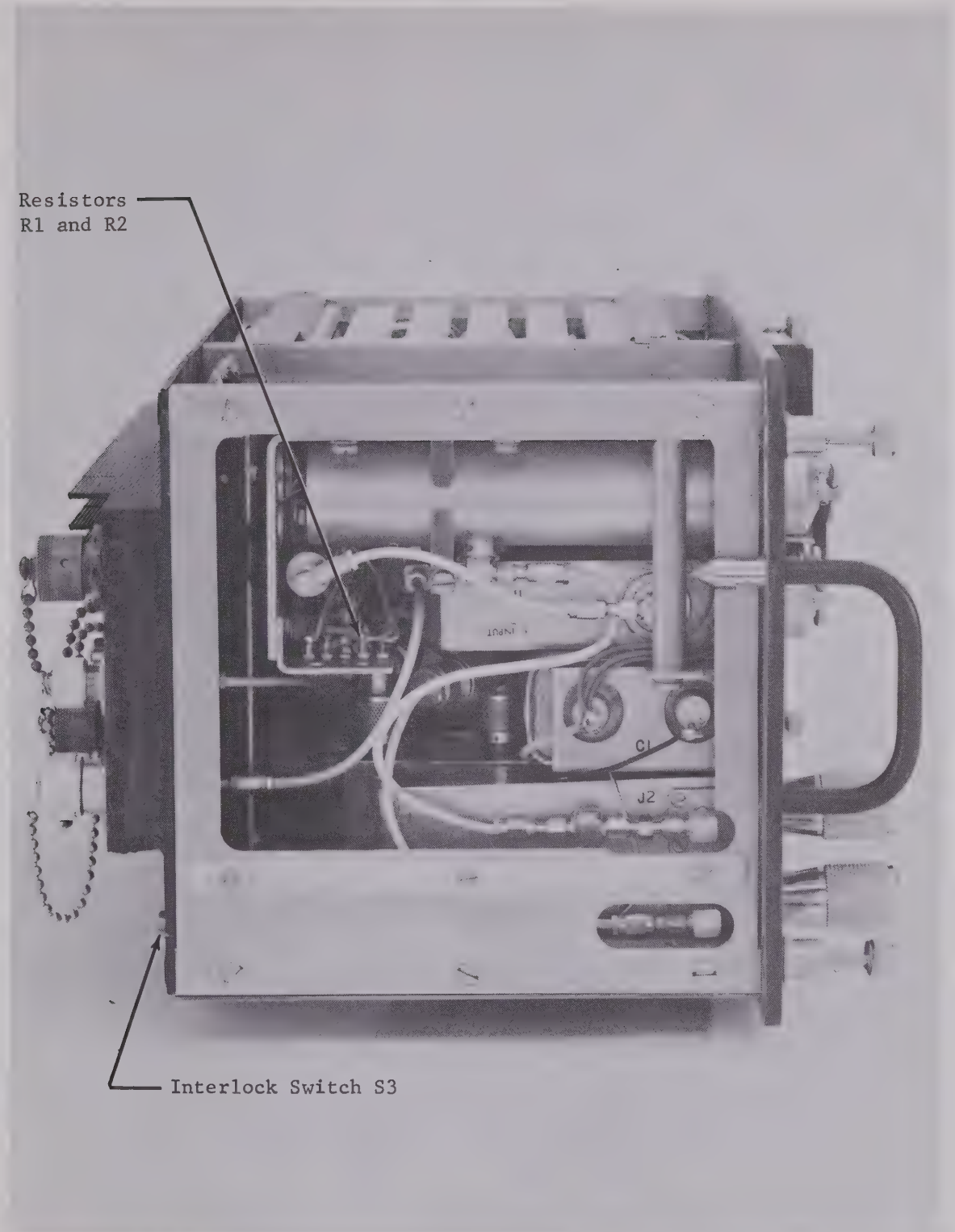


Figure 4-28. Left Side View of Transponder Assembly Showing Resistors R1 and R2 and Interlock Switch S3.

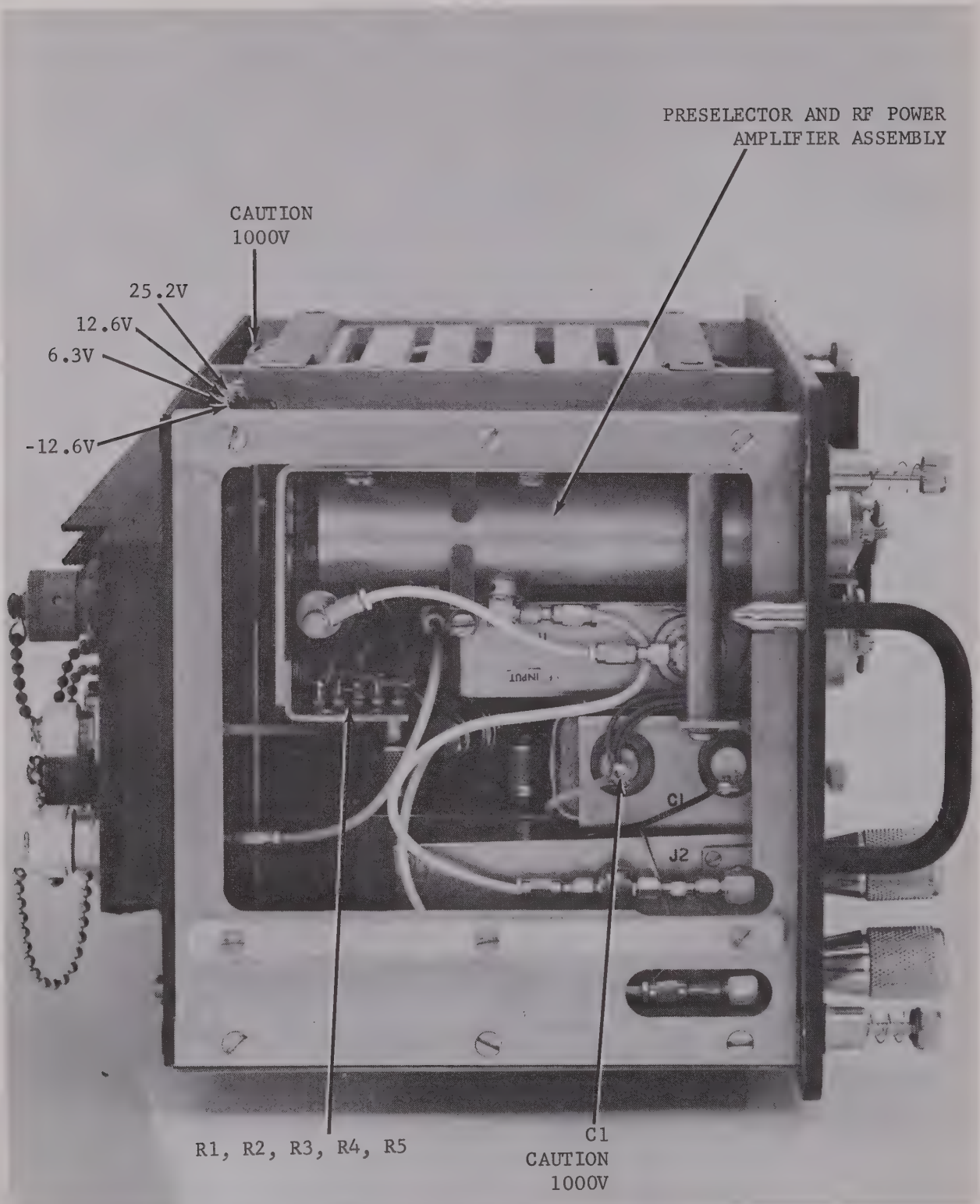


Figure 4-29. Terminals for Power Supply DC Voltages

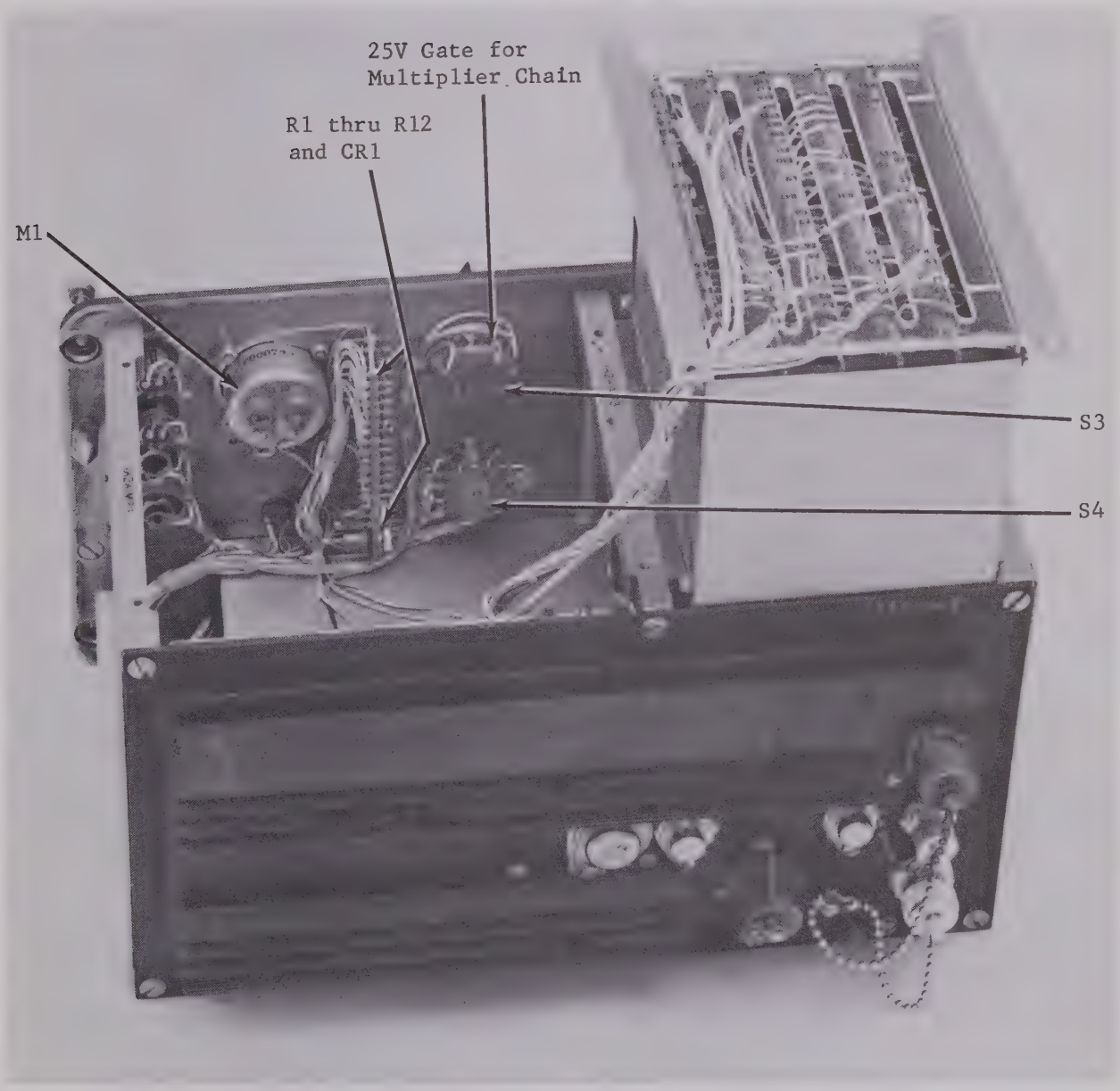


Figure 4-30. Rear View of the Front Panel Showing MODE Switch and Test Meter Circuit (With Card Cage Removed)

anode probe.

NOTE

When measuring droop, ascertain if the video detector operates in the linear detection region. By inserting an additional 6 db pad in front of the video detector, one can check if the video detector operates in the linear or square law region. If, after inserting the 6 db pad, the output signal of the video detector on the scope isless than 50% of the amplitude without 6 db pad, the detector does not operate in the linear detection region and the measured droop is greater than it is in reality.

4-13. POWER SUPPLY.-(Figure 5-33)

a. FUNCTIONAL DESCRIPTION.

(1) GENERAL.- (Figures 4-31 and 5-56)

(a) The various circuits in the Manpack TACAN transponder set require five DC supply voltages: 1000 V, 25.2 V, 12.6 V, -12.6 V and 6.3 V which are provided by the power supply.

(b) The entire power supply consists of the power source, a voltage regulator, and a converter.

(c) Only a floating DC power source shall be used. That means, neither +B nor -B shall be grounded. Otherwise, a damage of the power source or of the transponder voltage regulator can occur.

(2) OPERATION FROM A STORAGE BATTERY BB-451/U.-

(a) The transponder set can operate from a silver zinc alkaline 24 V (nominal) rechargeable storage battery capable of operating the transponder including the antenna drive for a minimum of 12 hours when the capacity of the battery is at least 20 ampere hours. This battery is clamped directly to the bottom of the transponder. The connector of the battery cable mates with that (A2J4) on the back of the transponder. It is possible to connect, externally, identical batteries in parallel to increase operation time. It is advisable not to discharge the battery below 23 V to avoid severe damage to the battery.

(b) When the test meter switch is in position BATT, and the pointer is in center position, the battery voltage indicated is 23 V.

(3) ALTERNATE POWER SUPPLY.-

(a) The alternate power supply can be used in lieu of a battery. It provides an unregulated but filtered DC output of 25 V nominal. This power supply can operate from a power source of 50 Hz to 450 Hz and 120 V ±10 percent single phase.

(b) The alternate power supply contains: a transformer; a bridge rectifier using silicon diodes; a choke-capacitor filter to reduce ripple; an "ON-OFF" switch S-1; two interlock switches, S-2 and S-3, mounted on the back of the interval chains; a green pilot light DS-1; and a red warning light DS-2 (when the interlock switch S-2 is cheated).

(c) Overload protection is provided by a fuse with lamp type blown fuse indicator. The bleeder resistor, R-1, prevents the DC output voltage from exceeding the breakdown voltage of the filter capacitors when the alternate power supply is unloaded.

(d) This power supply is clamped and connected to the transponder in the same manner as the battery.

(4) VOLTAGE REGULATOR.-

(a) The voltage regulator controls the effort of amplitude

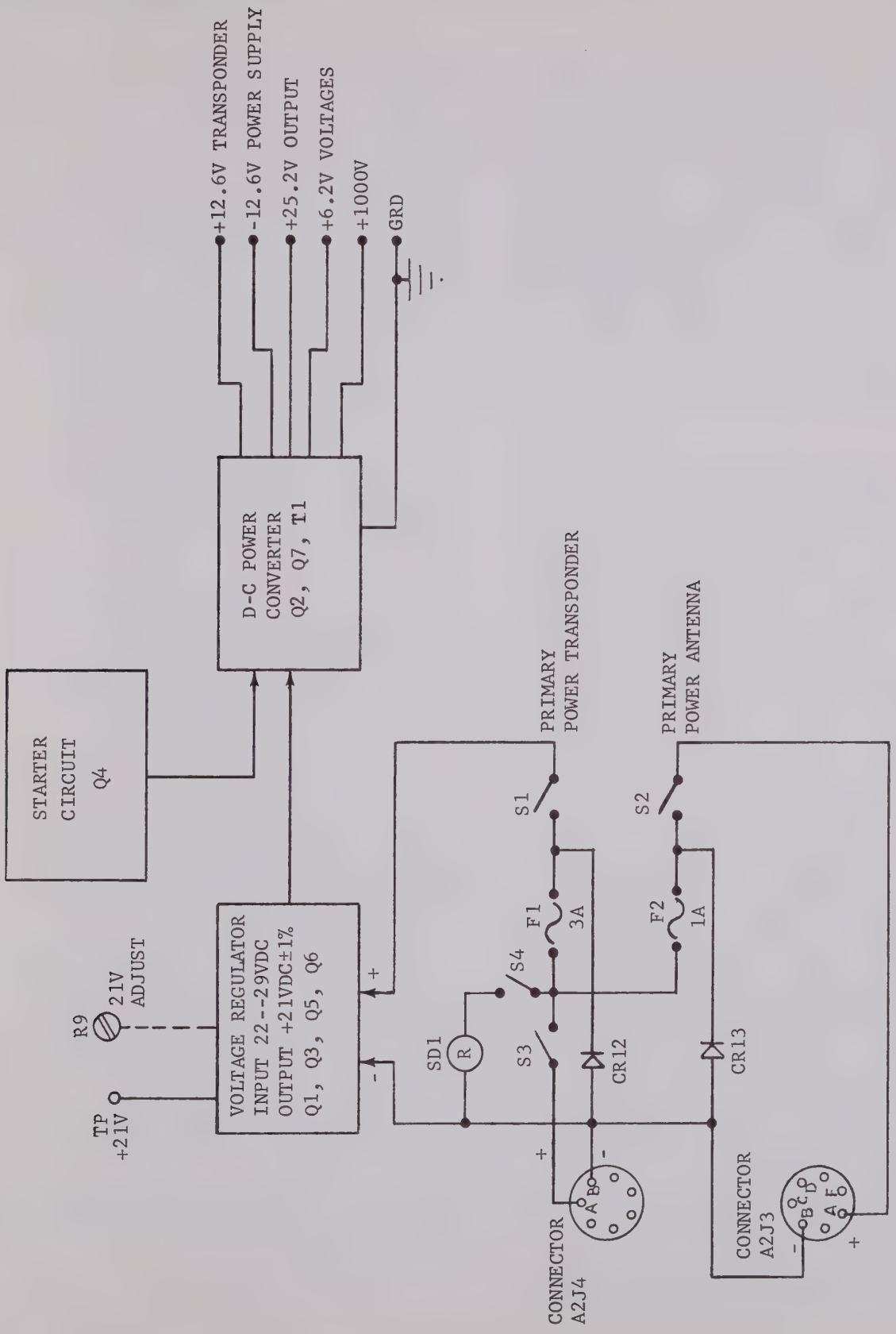


Figure 4-31. Transponder Power Supply, Functional Block Diagram

variation of the power source and provides low output impedance. It consists of a series control device, an amplifier, a comparison circuit, a reference device, and a sampling circuit. The sampling circuit, R4, R9, R11, is a resistive voltage divider across the load. The comparison circuit, Q5 and Q6, is an emitter coupled differential amplifier. The reference device, CR8 is a temperature compensated voltage reference diode. The reference voltage of this diode is applied to the base of Q5 and a sample of the output voltage is applied to the base of Q6.

(b) The sample of the output voltage is thus compared with the reference voltage of CR8. When an error voltage exists, the difference voltage is amplified and applied to the control element Q1. The resistance of the control element is varied to maintain the output voltage constant. Due to the relatively low current available from the differential amplifier, transistor Q1 is driven by one additional driver stage Q3.

(5) OVERLOAD AND REVERSE VOLTAGE PROTECTION.-

(a) The maximum load current is limited by the drive current available from Q5 which in turn is limited by Resistor R10. A temporary overload on Resistor R10 will not damage the regulator. However, an overload will cause a fuse blow-out, thus preventing damage to the system.

(b) If a supply voltage with reverse polarity to connector A2 4 is applied, the diodes CR12 and CR13 are forward biased, and will draw excessive current which, in turn will blow the fuses F1 and F2.

(6) DC-DC CONVERTER.-

(a) The purpose of the converter is to efficiently convert the regulated DC output voltage of the voltage regulator to five DC voltages of different levels. The main parts of the converter are the two power transistors, Q2, Q7, and a special transformer T1. The transistors and the transformer are connected in such a way that a regenerative switching action occurs between the two transistors. The windings 2-3 and 5-6 provide the feed-back and the resistors R1 and R13 limit the base current of the transistors. The output of the secondary windings, excluding the 1000 V supply, is rectified by the full-wave rectifiers. Low pass filters reduce the ripple of the rectified square wave. For the 1000 V supply a voltage doubler circuit has been used. The resistors R14, R15, and R16 keep the high voltage capacitors C18 and C19 discharged when power is turned off.

(b) Transistor Q4 serves to turn on the converter. When supply voltage is applied to the voltage regulator charge current of the capacitor C12 causes temporary conduction of transistor Q4 which will start the regenerative action of the converter.

(7) INTERLOCK SWITCHES.-

(a) If the transponder has to be operated outside of its case for maintenance purposes interlock switch S3, mounted on power supply heat sink, must be cheated.

(b) Interlock switch S4 is closed only when the transponder is outside the case. A red warning light on the front panel indicates that interlock switch S3 has been cheated. (Figure 4-28)

b. ALIGNMENT.-

(1) TRANSPONDER.-

(a) Only the DC output voltage of the power supply voltage regulator (See Paragraph 4-13a, (4)) has to be aligned.

(b) Adjust variable

resistor R9 (Figures 5-33, and 5-56) for 21 VDC ±.01% measured across E3 (plus) and E12 (minus).

(c) For this adjustment, the power supply input voltage should be +24 VDC for such a load that the input current of the power supply is approximately 1.5A.

(2) ALTERNATE POWER SUPPLY.- For the ALTERNATE POWER SUPPLY, no alignment is required.

c. TROUBLE SHOOTING.-

(1) OVERALL CHECK.-

(a) When the transponder fails to function, check the following:

(b) Battery voltage on the test meter;

(c) All DC power supply voltages on the test meter;

(d) Fuses on transponder;

(e) Power cables and cable connectors;

(f) Cable connection on battery or ALTERNATE POWER SUPPLY;

(g) Battery charged;

(h) Pilot light, power switch and interlock switches if ALTERNATE POWER SUPPLY is used;

(i) Proper setting of interlock switches on transponder; and

(j) Measure DC current of the transponder, nominal 1.5A at +25°C.

(2) TRANSPONDER.-

(a) The test meter reading for 21 V, 6.3 V, 12.6 V, -12.6V, 25.2 V, and 1000 V should be close to red line on the meter scale.

(b) In test meter switch position "BAT" the meter reading should never be below approximately 30% of the full scale reading, otherwise, the DC supply voltage to the transponder is too low. When a BB-541/U type battery is being used, the meter reading should not go below red line (23 V) to prevent the very delicate battery from being over-discharged.

(c) If the test meter readings for the DC voltage mentioned above, except in test switch position BAT, is below red line when the transponder power supply circuit is probably overloaded. Overload is caused by excessive current drain of a faulty circuit of the transponder by a faulty component of the power supply itself. In this case, turn off the transponder immediately to avoid further damage. Proceed trouble shooting to determine if the power supply or another circuit of the transponder has failed.

Warning

Operation of this equipment involves the use of HIGH VOLTAGES which are dangerous to life. Do not change transistors or components inside the transponder case with the power switch ON. Do not depend upon safety interlock switches for protection. Under certain conditions, dangerous potentials exist in the circuit with power controls in the OFF position due to charges retained by capacitors. To avoid shock and severe burns, always discharge and ground circuits before touching them. Never service or adjust the equipment without the presence or the assistance of another person capable of rendering first aid immediately.

Remove the transponder from the case (See Section 5).

(d) When any malfunction of a circuit is present, turn the transponder on only for a short measuring time to avoid more damage.

(e) Unsolder the 1000 VDC supply to the tubes at terminal E9 located on top of the power supply assembly and check the other DC supply voltages again. The voltage of the 1000 V supply is somewhat higher than nominal if unloaded.

(f) Proceed in the same way in disconnecting one DC voltage after another until the defective circuit has been located. Always disconnect 1000 VDC first, otherwise the tubes might lose their bias and will be damaged.

Note

Never turn on the transponder power supply when on DC output voltage supply is disconnected from the load. The filter capacitors will be changed to the voltage peak value (spike) of the rectified square wave of the converter and the break-down voltage of the filter capacitors can be exceeded. Except for the 1000 V supply, which has built-in discharge resistors (in Figure 5-33, R14, R15, and R16), solder a 560 Ω 1 W resistor from the terminals E1, E4, E5, E7 when unloaded to the nearest ground lug.

(3) TRANSPONDER POWER SUPPLY.-

(a) If the fault has been traced back to the power supply, the power supply assembly has to be disassembled from the transponder (Section 5, Paragraph 5-3) but do not disconnect the primary power wires (E11, E12, and E13). Disconnect all wires from the terminals E1, E4, E5, E7 to the transponder and solder a 560 Ω 1 W load resistor on each of these terminals to ground (do not connect an external load resistor to the 1000 V (E9)) terminal. Set (pull) interlock switch S3 so that the power supply receives primary power.

(b) Remove lid and connect the power supply circuit to an external 24 VDC 2A supply using the power cable W7. The connector of power cable W7 mates connector J4 on the power supply chassis.

(c) If the external primary power wires from E11, E12, E13 to the front panel (switches and fuses) of the transponder are disconnected, feed primary power (24 VDC, 2A) to terminals E13 (plus) and E12 (minus). In this case provide sufficient protection (current circuiting of external 24 V supply or fuse 3A) that input current cannot exceed temporary 3A.

(d) First check voltage regulator (Paragraph 4-13a(4)) for proper operation. If necessary disconnect the voltage regulator from the converter (wire to collector of Q2 and Q7).

(e) The converter (Q2 and Q7) starts operation only when triggered by transistor Q4 (Paragraph 4-13 a(6)). Turn external 24 V power supply off and on again.

(f) Use an oscilloscope to check operation of the converter. The frequency is about 15 to 20 KHz. Most likely trouble spots are: filter capacitors C9, C10, C2, C3, C5, C6, rectifier CR1 through CR11, depending on which voltage supply was overloaded or defective.

(g) When checking rectifiers CR10 and CR11, test for 1000 V reverse voltage. Lower test voltage

might not reveal a defect.

(h) If the converter does not operate at all, check voltage regulator output voltage (21 VDC), transistors Q2, Q7, and Q4.

(4) ALTERNATE POWER SUPPLY.- When the alternate power supply does not function properly, check fuse, pilot light, interlock switches, and measure the output voltage. The output voltage of the alternate power supply is 26 VDC ±1 V for 120 V input voltage and 1.5A load. For no load condition, the output is about 45 VDC. When the ripple for 60 Hz operation exceeds 2 V pp (loads 1.5A) the filter capacitor should be checked and replaced if defective.

4-14. ANTENNA GROUP.-

a. GENERAL.- The antenna group consists of the following:

(1) 15 Hz single lobe antenna;

(2) Antenna drive motor and speed control;

(3) North reference trigger circuitry;

(4) Inter-connecting circuitry;

(5) Tripod assembly;

(6) Level indicator;

(7) Magnetic compass; and,

(8) Carrying case.

b. 15 Hz SINGLE LOBE ANTENNA.

(1) The r-f portion of the antenna consists primarily of two separate items: (a) a rotating parasitic reflector element mounted on a fiberglass support arm, and (b) a two element central array. These two items are mechanically and electrically mated to the remainder of the antenna assembly.

(2) The counter balanced fiberglass support arm which supports the parasitic reflector element (Figure 5-5) is mounted directly to the rotating pulser plate. The parasitic reflector element consists of very fine nichrome resistance wire sections cemented to the vertical member of the fiberglass support arm. The complete parasitic element is configured and mounted (relative to the central array) in a manner which results in the generation of a cardeoid pattern and an up-tilt of the 15 cycle sideband energy which equals or exceeds the uptilt of the carrier energy. When the pulser plate is rotated at 900 RPM, the parasitic element rotates around the central array and produces a 15 Hz amplitude modulation of the pulsed carrier signal as seen at a fixed point some distance from the antenna. In this manner a nominal 20 percent modulation at the horizon is obtained. A horizontal fiberglass cross member and associated weight is part of the reflector support arm assembly and effectively performs the function of dynamically balancing the offset reflector support arm during rotation. The entire support arm is streamlined to reduce air drag and thereby reduce the drive motor power requirement.

(3) The central array is constructed from a length of 50 Ω, solid copper jacket, coaxial transmission line approximately 14 inches long and 5/16 inches in diameter. For a length in excess of three inches the outer conductor is removed from the upper portion of the transmission line which exposes only the modifed center conductor. This three inch section is referred to as the "upper radiator". A skirt is attached to the outer conductor at the base of the "upper radiator". This skirt is referred to as the "upper skirt." The upper radiator and skirt are together referred to as the "upper radiating assembly."

(4) The "upper radiator" is cut slightly longer than an effective quarter wavelength at the center operating frequency so as to present an inductive reactance. The "upper skirt" is cut slightly less than an effective quarter wavelength at the center frequency which results in a capacitive reactance as seen by the driving voltage. This condition causes the energy flow in the upper radiator to be retarded slightly with respect to that in the "upper skirt." This results in the maximum radiation being directed above a horizontal line perpendicular to the axis of the system at the feed point. This design is utilized in order to achieve an uptilt characteristic of the radiated signal. The "upper skirt" being a little short of a quarter wavelength allows some current to flow down the outside of the transmission line. In order to have the radiation from these currents add constructively rather than destructively to the main radiation characteristics, care must be taken in the design of other mechanical structures of the antenna.

(5) The rigid coaxial transmission line which physically supports and electrically feeds the "upper radiating assembly" extends through a metal bushing which electrically connects the outer conductor of the transmission line to the stationary (inner) portion of the main support for the rotating assembly. A "lower skirt" assembly is mounted to this stationary support via the upper and lower bearings. The "lower rotating skirt" rotates with the rotating assembly. The short portion of rigid transmission line between the upper and lower skirts is called the "lower radiator." The "lower radiator" and the "lower rotating skirt" are together referred to as the "lower radiating assembly." The upper and lower rotating assemblies make up the two element central array.

(6) Leakage currents flowing down the outside of the "lower radiator" as described above continue down and across the "lower rotating skirt." The "lower rotating skirt" and surrounding antenna configuration functions to reduce these currents. The "lower radiating assembly" acts as a low powered radiator with uptilt and assists in the formation of the uptilt of the main radiation pattern.

(7) Preservation of constant impedances through which these currents flow is very necessary. Current flowing from the "lower radiator" to the "lower rotating skirt" must flow across the upper bearing. Since the bearing does not necessarily have a constant impedance, a low impedance is reflected in parallel with the upper bearing impedance through the use of a special choke joint.

(8) (Figure 4-32) Walls a and b form a transmission line of a quarter wavelength below the bearing. This transmission line is terminated by gap 'G.' This gap feeds into another gap 'g' which is in series with the lower bearing. Gap 'g' is the open circuit end of a short circuited transmission line, also a quarter wavelength long, whose walls are d and e. Therefore, the impedance across gap 'g' is infinite. If the lower bearing is either short circuited or varies to an open circuit, the impedance that gap 'G' sees is the infinite impedance at 'g' plus the variable impedance of the bearing. The resultant impedance is therefore very high. The very high impedance at gap 'G' reflects a very low impedance across the upper bearing. This low impedance provides an unimpeded path for currents flowing from the lower radiator to the rotating skirt.

c. ANTENNA SPEED CONTROL.- To drive the parasitic element at a uniform 900 rpm a reduction drive with a gear ratio of 6:1 is used on a DC motor operating at 5400 rpm. The DC motor is controlled by the motor speed control unit which pulse-duration modulates the DC current applied to the motor. When the motor and the speed control becomes defective, it should be replaced.

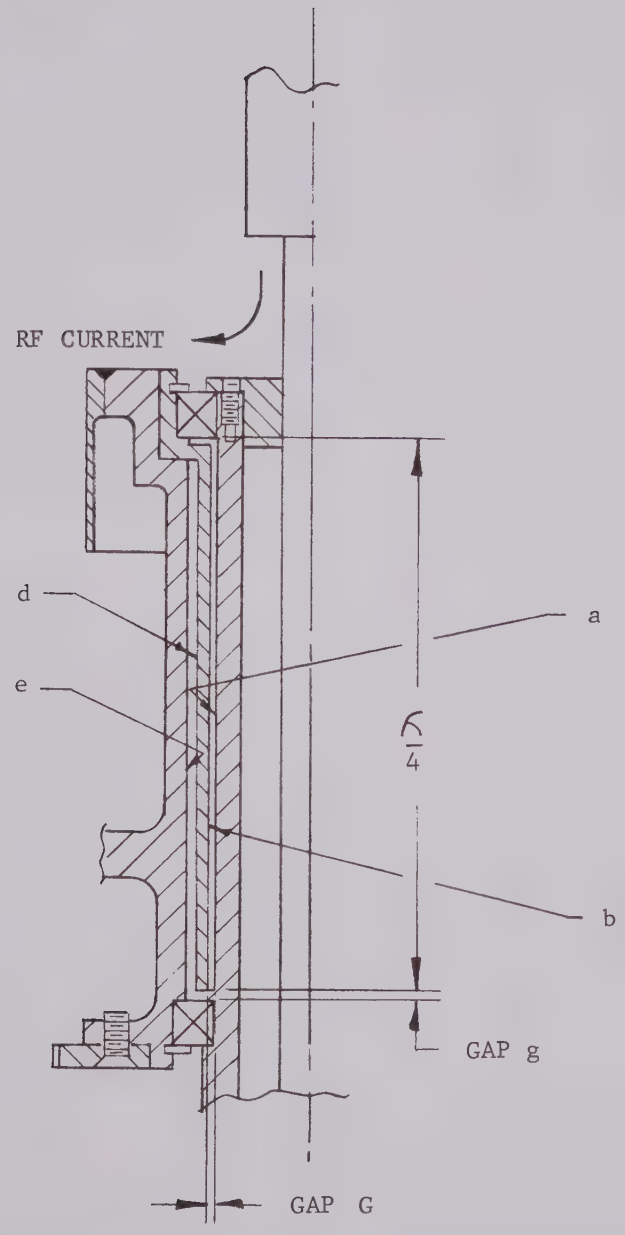


Figure 4-32. Antenna RF Choke Joint Assembly

d. NORTH REFERENCE TRIGGER.- (Figure 5-49)

The pulser plate is provided with a narrow slot. A photo transistor and an incandescent lamp are mounted in such a way that, when the pulser plate is rotating and the slot passes the photo transistor, the photo transistor receives a short light pulse which in turn will draw current and generate a negative going pulse at the collector. This pulse is fed via cable W6 to the control circuit located in the transponder where it will initiate the north burst.

e. INTER-CONNECTING CIRCUITRY.-

(1) Coaxial cable W5P1 connects the central array antenna to the transponder antenna connector J1.

(2) Coaxial cable W6P1 connects the north reference trigger to the transponder assembly.

(3) Cable marked W4P1 connects the antenna drive motor and the north reference trigger lamp from the antenna assembly to the transponder assembly.

f. TRIPOD ASSEMBLY.-

(1) The antenna tripod supports the antenna assembly and consists of an antenna support fitting, a swivel joint base plate assembly, and three adjustable tripod legs.

(2) The antenna support fitting is mounted inside the swivel joint, and its function is to provide a mount for the antenna assembly.

(3) The swivel joint and base plate assembly consists of a monoball bearing retained within the base plate housing. The outer race of the monoball bearing has one section split away from the rest of the race so that a cam acting against this movable section can be used to tighten the control head assembly in the desired position. A monoball locking knob is located on the tripod mounting base, or if out of reach, because of extended height, the locking knob at the end of the locking shaft can be used. This secures the center extension tube assembly.

(4) The compass with bubble level is mounted on the base plate of the center extension tube.

(5) The needle of the compass is induction-damped. A needle lock is provided to prevent the compass from being damaged when not used during transport.

(6) The antenna tripod consists of three tubular telescoping legs, each leg hinged to the antenna baseplate and pointed at the bottom for attachment to the ground. Each leg of the tripod is made up of three sections of thin-walled aluminum tubing, the lower section sliding inside the upper section. Each section is clamped together by means of a split tube and a sleeve arrangement. As the sleeve, a knurled locknut, is tightened, the outer tube is clamped down on the inside tube preventing any slippage between the two tubes. Adjustments in the height of the tripod can be made by loosening the knurled locknuts, making the adjustments in length and then retightening the locknuts.

(7) A mounting clamp with a locknut is provided for the transponder on the base plate of the center extension tube directly below the compass.

TABLE 4-1. WAVEFORM PICTURES OF MANPACK LOGIC CARDS AT ROOM TEMPERATURE

PICTURE NO.	LOCATION	CONDITION	FURTHER DESCRIPTION
1	level detector E6	2 V/cm 10 μsec/cm external sync from signal generator	interrogation pulse-pair, receiver noise and blanking gates coinciding with reply pulse-pair
2	level detector E6	0.5 V/cm 10 μsec/cm internal sync	noise input without interrogation and random blanking gates.
3	level detector E6	1 V/cm 50 μsec/cm external sync Control II E11 board 4	noise input without interrogation plus blanking gates during north burst.
4	level detector E5 also at modulator E7	10 V/cm 2 μsec/cm internal pos. sync	blanking gate pair.
5	level detector E5 also at modulator E7	10 V/cm 20 μsec/cm internal pos. sync	blanking gate input pulse-pair showing deadtime.
6	level detector E5 also at modulator E7	10 V/cm 100 μsec/cm external sync Control II E11 board 4	blanking gates input during north burst observe freedom of random pulses during north burst. Also pre- and post-gating.
7	level detector base Q1	2 V/cm 10 μsec/cm external sync from signal generator	delay line out under normal interrogation.
8	level detector emitter Q2	2 V/cm 10 μsec/cm external sync signal generator	"AC" channel output to tunnel diode.
9	level detector cathode CR2	2 V/cm 5 μsec/cm external sync from signal generator	peak detector.
10	level detector emitter Q10	2 V/cm 5 μsec/cm external sync from signal generator	"DC" channel output.
11	level detector base Q6	2 V/cm 5 μsec/cm external sync from signal generator	"DC" channel at tunnel diode.
12	level detector E8 or decoder E4	5 V/cm 10 μsec/cm external sync from signal generator	level detector output, decoder input, random plus interrogation.

TABLE 4-1.- (cont)

PICTURE NO.	LOCATION	CONDITION	FURTHER DESCRIPTION
13	level detector E8 or decoder E4	5 V/cm 0.5 μsec/cm internal sync	level detector output, decoder input, random plus interrogation.
14	level detector E11	5 V/cm 10 μsec/cm external sync from signal generator	output of reset delay MV showing primary, reply and random triggering.
15	level detector E11	5 V/cm 50 μsec/cm internal pos. sync	output of reset delay MV.
16	level detector E11	5 V/cm 50 μsec/cm external sync Control II E11 board 4	reset delay MV output during north burst.
17	level detector collector Q13	2 V/cm 5 μsec/cm external sync from signal generator	reset MV output showing primary, reply and random triggering.
18	level detector collector Q13	2 V/cm 0.2 μsec/cm internal pos. sync	reset MV output.
19	decoder emitter Q13	2 V/cm 5 μsec/cm external sync from signal generator	delay line input under normal interrogation.
20	decoder 9 μsec tap on delay line	2 V/cm 5 μsec/cm external sync from signal generator	observe trigger pips on pos. slope because of tunnel diode firing.
21	decoder base Q17	0.5 V/cm 5 μsec/cm external sync from signal generator	voltage across tunnel diode.
22	decoder collector Q17	5 V/cm 5 μsec/cm external sync from signal generator	tunnel diode pickoff output.
23	decoder collector Q3	2 V/cm 5 μsec/cm external sync from signal generator	decoder Flip-Flop output.
24	decoder emitter Q5	2 V/cm 5 μsec/cm external sync from signal generator	AND gate output.

TABLE 4-1.- (cont)

PICTURE NO.	LOCATION	CONDITION	FURTHER DESCRIPTION
25	decoder collector Q7	2 V/cm 5 μsec/cm external sync from signal generator	7 μsec MV output.
26	decoder 15 μsec delay line output	2 V/cm 5 μsec/cm external sync from signal generator	observe trigger pips on pos. slope because of tunnel diode firing.
27	decoder collector Q14	5 V/cm 5 μsec/cm external sync from signal generator	tunnel diode pickoff output.
28	decoder collector Q9	2 V/cm 5 μsec/cm external sync from signal generator	0.2 μsec MV output.
29	decoder anode CR2	1 V/cm 5 μsec/cm external sync from signal generator	
30	decoder E5 or ARRC E6	5 V/cm 10 μsec/cm external sync from signal generator	decoder output.
31	decoder E5 or ARRC E6	5 V/cm 0.2 μsec/cm internal sync	decoder output.
32	ARRC board 3 E5	5 V/cm 20 μsec/cm internal sync	4 μsec MV output.
32A	Control I board 3 emitter Q23	2 V/cm 5 μsec/cm external sync from signal generator	representative of input to control section from ARRC circuit.
33	Control I board 3 E11	2 V/cm 10 μsec/cm internal sync	output to delay line on board 4.
34	Control II board 4 27 μsec delay line tap	1 V/cm 10 μsec/cm external sync from signal generator	control circuit delay line output resulting from interrogation.
35	Control II board 4 E5 also at modulator E5	5 V/cm 20 μsec/cm internal sync	output to modulator.

TABLE 4-1.- (cont)

PICTURE NO.	LOCATION	CONDITION	FURTHER DESCRIPTION
36	Control II board 4 E5 also at modulator E5	5 V/cm 0.5 μsec/cm internal sync	output to modulator.
37	Control I board 3 collector Q25	1 V/cm 10 μsec/cm internal sync	echo suppression MV output.
38	Control I board 3 E17	2 V/cm 10 μsec/cm internal sync	deadtime gate from echo suppression MV.
39	Control I board 3 E16	1 V/cm 100 μsec/cm external sync Control II E11 board 4	pulser plate input to control.
40	Control I board 3 E15	5 V/cm 100 μsec/cm external sync Control II E11 board 4	pulser plate amplifier output.
41	Control II board 4 E11	2 V/cm 50 μsec/cm internal sync	north burst gate.
42	Control II collector Q16	5 V/cm 50 μsec/cm external sync Control II E11 board 4	inverted north burst gating MV output to AND gate 2.
43	Control I board 3 E12	2 V/cm 10 μsec/cm internal sync	line clearing MV output.
44	Control I board 3 collector Q20	2 V/cm 10 μsec/cm external sync Control II E11 board 4	4 μsec shaper MV #1 output during north burst.
45	Control I board 3 cathode CR17	2 V/cm 100 μsec/cm external sync Control II E11 board 4	OR gate 1 output during north burst.
46	Control I board 3 E11	5 V/cm 100 μsec/cm external sync Control II E11 board 4	north burst into delay line.
47	Control II board 4 27.5 μsec delay line tap	2 V/cm 50 μsec/cm external sync Control II E11 board 4	signal during north burst.
48	Control II board 4 collector Q5	2 V/cm 50 μsec/cm external sync Control II E11 board 4	tunnel diode pickoff output during north burst.

TABLE 4-1.- (cont)

PICTURE NO.	LOCATION	CONDITION	FURTHER DESCRIPTION
49	Control II board 4 emitter Q15	2 V/cm 50 μsec/cm external sync Control II E11 board 4	AND gate 2 output during north burst.
50	Control II board 4 collector Q13	2 V/cm 50 μsec/cm external sync Control II E11 board 4	pulse spacing MV output during north burst.
51	Control II board 4 collector Q11	2 V/cm 50 μsec/cm external sync Control II E11 board 4	4 μsec shaper MV #2 output during north burst.
52	Control II board 4 E10	5 V/cm 50 μsec/cm external sync Control II E11 board 4	output Q10 during north burst.
53	Control II board 4 E5 also modulator E5	5 V/cm 100 μsec/cm external sync Control II E11 board 4	north burst to modulator.
54	upper modulator board 5 E5 lower Control II board 4 E11	both 10 V/cm 50 μsec/cm external sync Control II E11 board 4 E6 level detector board 1 and E4 on ARRC board 3 grounded	output to modulator and north burst gate to show proper alignment.
55	Control I board 3 E17	2 V/cm 100 μsec/cm internal sync	deadtime with North Burst (North Burst gating MV plus echo suppression MV).
56	modulator collector Q2	2 V/cm 0.5 μsec/cm internal pos. sync	fine control overall delay MV.
57	modulator collector Q4	5 V/cm 2 μsec/cm internal pos. sync	pulse spacing MV output.
58	modulator emitter Q5	2 V/cm 2 μsec/cm internal neg. sync	trigger pulse-pair.
59	modulator collector Q12	5 V/cm 2 μsec/cm internal pos. sync	3.4 μsec pulse-pair.
60	modulator emitter Q13	5 V/cm 2 μsec/cm internal pos. sync	pulse-pair at input of Gaussian filter.

TABLE 4-1.- (cont)

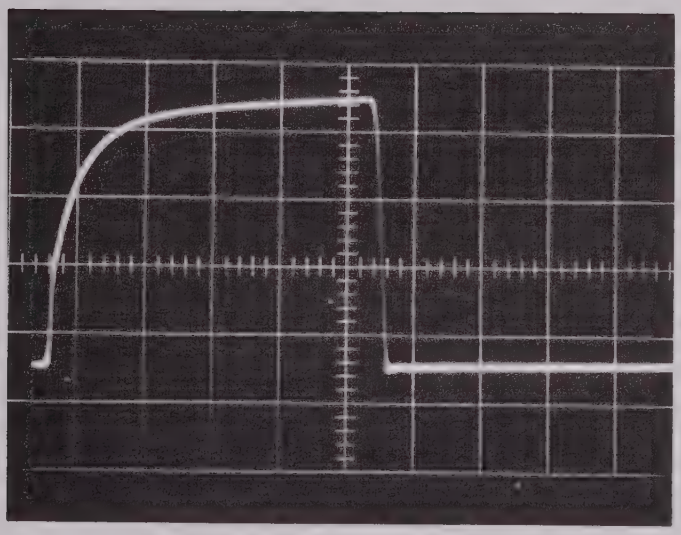
PICTURE NO.	LOCATION	CONDITION	FURTHER DESCRIPTION
61	modulator emitter Q14	5 V/cm 2 μsec/cm internal pos. sync	pulses out of Gaussian filter.
62	modulator collector Q17	2 V/cm 2 μsec/cm internal pos. sync	output of 1 μsec pedestal delay MV.
63	modulator collector Q19	2 V/cm 2 μsec/cm internal pos. sync	output of 6 μsec pedestal MV.
64	modulator anode CR9	1 V/cm 2 μsec/cm internal pos. sync	Gaussian plus pedestal prior to amplification.
65	modulator E6	5 V/cm μsec/cm internal sync	output Gaussian plus pedestal pulse-pair to tubes.
66	modulator E6	5 V/cm 20 μsec/cm internal sync	picture to show deadtime after output pulse-pair.
67	modulator collector Q21	5 V/cm 2 μsec/cm internal neg. sync	keying gate.
68	modulator collector Q4	5 V/cm 50 μsec/cm external sync Control II E11 board 4	pulse spacing MV output during north burst.
69	modulator emitter Q5	2 V/cm 50 μsec/cm external sync Control II E11 board 4	trigger pulse-pairs during north burst.
70	modulator emitter Q14	5 V/cm 50 μsec/cm external sync Control II E11 board 4	Gaussian pulse-pairs out of filter during north burst.
71	modulator anode CR9	1 V/cm 50 μsec/cm external sync Control II E11 board 4	Gaussian plus pedestal pulse-pairs prior to amplification, during north burst.
72	modulator E6	10 V/cm 100 μsec/cm external sync Control II E11 board 4	modulator output during north burst.
73	power supply 25 V secondary to ground	10 V/cm 20 μsec/cm internal sync	

Figure 4-33. Level Detector Waveforms (Pictures 1-4)

Figure 4-34. Level Detector Waveforms (Pictures 5-8)

Figure 4-35. Level Detector Waveforms (Pictures 9-12)

Figure 4-36. Level Detector Waveforms (Pictures 13-16)



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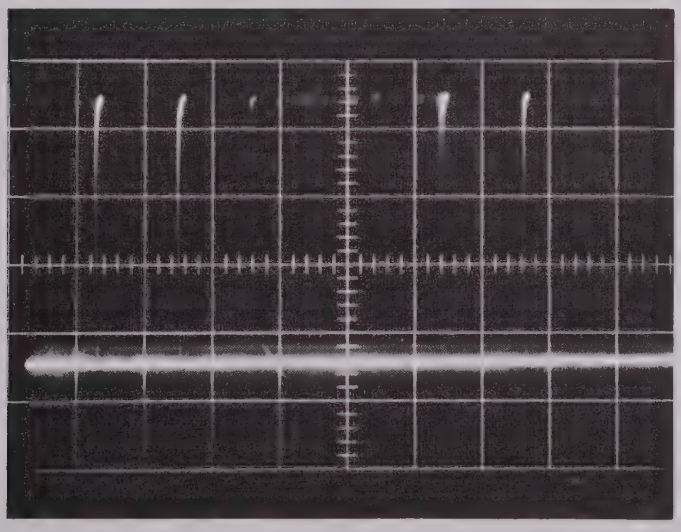
LEVEL DETECTOR COLLECTOR Q13



17

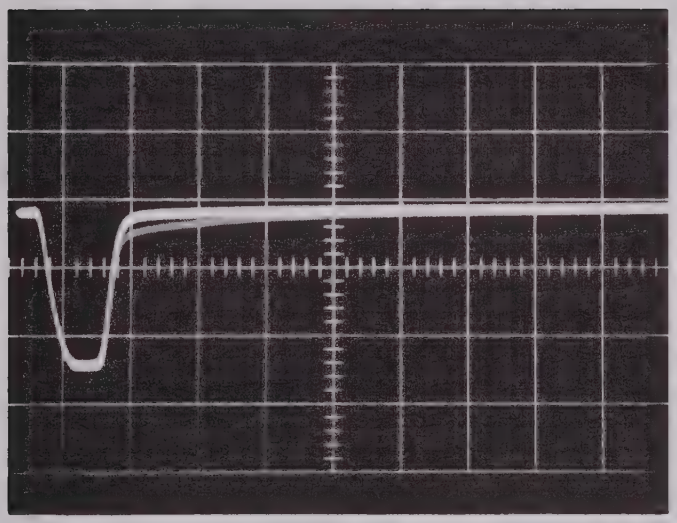
LEVEL DETECTOR COLLECTOR Q13

Figure 4-37. Level Detector Waveforms (Pictures 17 and 18)

Figure 4-38. Decoder Waveforms (Pictures 19-22)

Figure 4-39. Decoder Waveforms (Pictures 23-26)

Figure 4-40. Decoder Waveforms (Pictures 27-30)



DECODER E5 OR ARRC E6

Figure 4-41. Decoder Waveform (Picture 31)

Figure 4-42. Control Board Waveforms (Pictures 32-34)

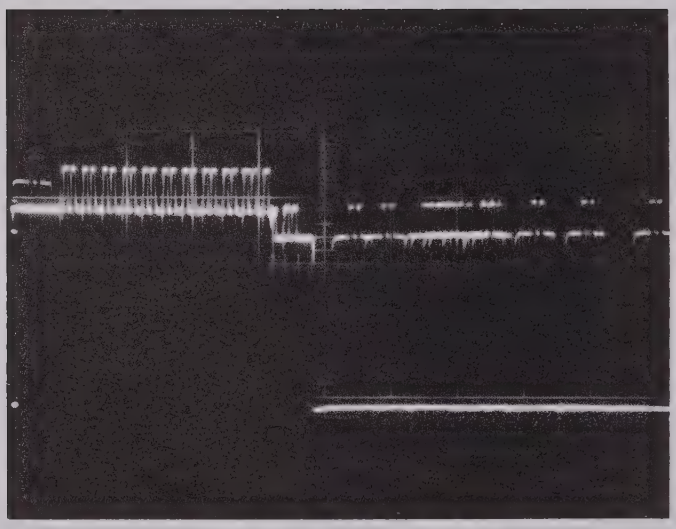
Figure 4-43. Control Board Waveforms (Pictures 35-38)

Figure 4-44. Control Board Waveforms (Pictures 39-42)

Figure 4-45. Control Board Waveforms (Pictures 43-46)

Figure 4-46. Control Board Waveforms (Pictures 47-50)

Figure 4-47. Control Board Waveforms (Pictures 51-54)



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CONTROL I BOARD 3 E17

Figure 4-48. Control Board Waveform (Picture 55)

Figure 4-49. Modulator Waveforms (Pictures 56-59)

Figure 4-50. Modulator Waveforms (Pictures 60-63)

Figure 4-51. Modulator Waveforms (Pictures 64-67)

Figure 4-52. Modulator Waveforms (Pictures 68-71)

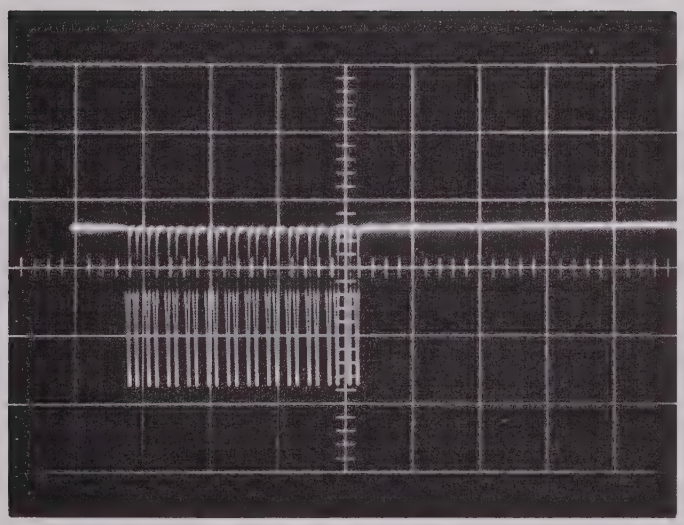
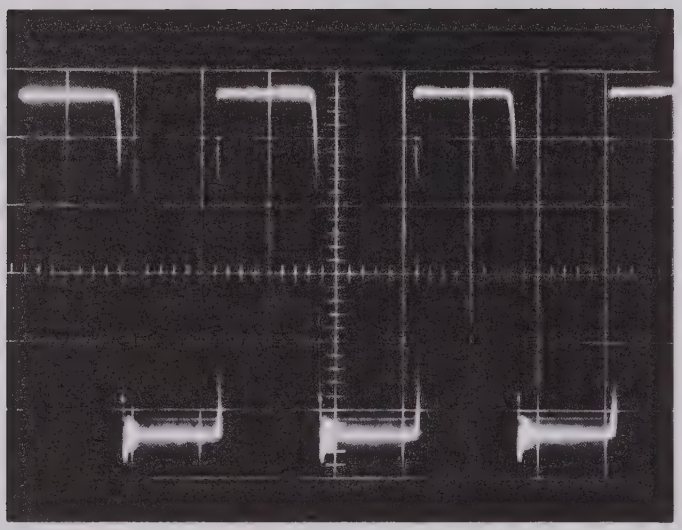


Figure 4-53. Modulator Waveform (Picture 72)



POWER SUPPLY 25 V SECONDARY TO GROUND

Figure 4-54. Power Supply Waveform (Picture 73)

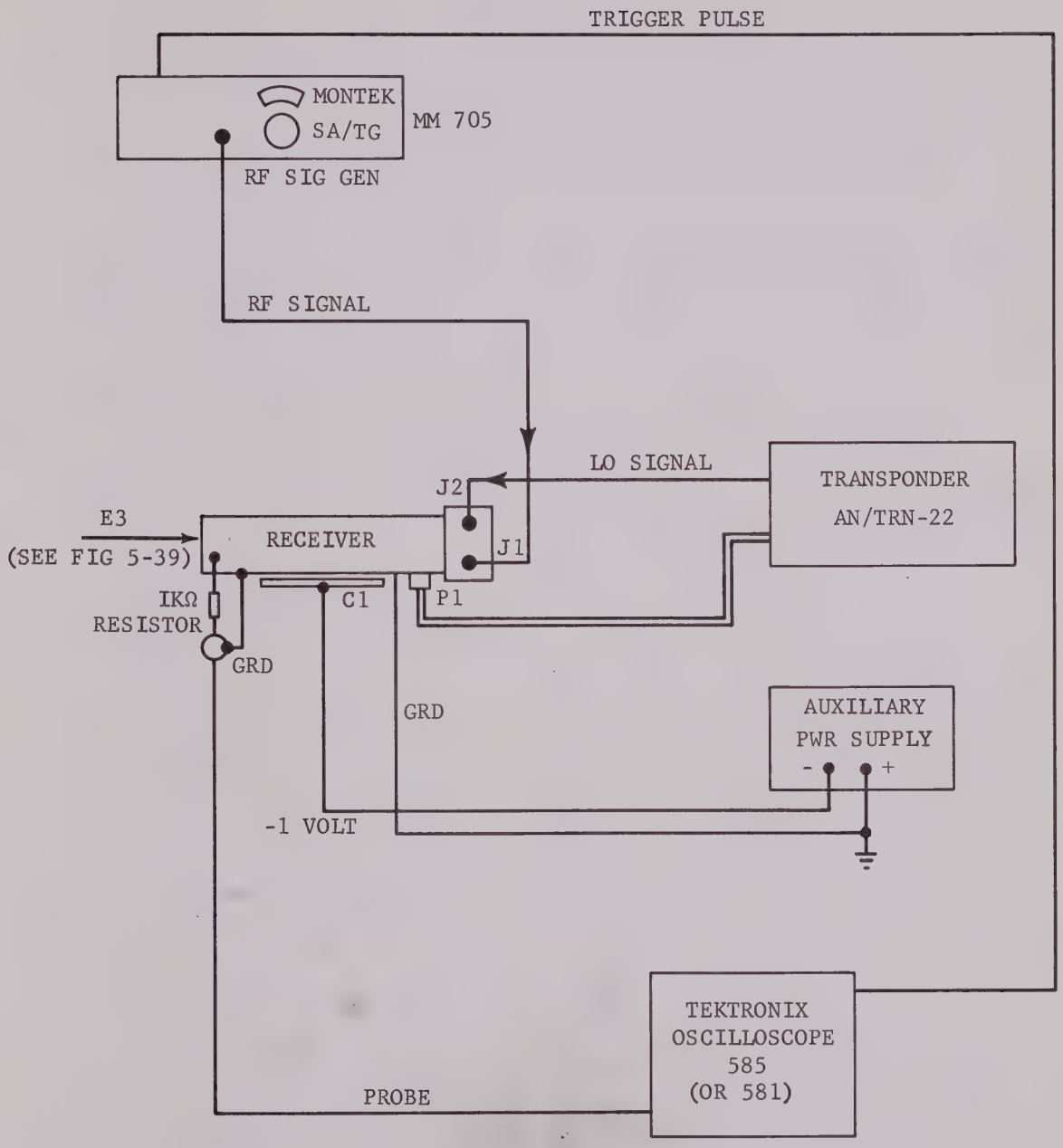


Figure 4-55. Receiver Alignment Setup

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SECTION 5

MAINTENANCE

5-1. FAILURE, PERFORMANCE AND OPERATIONAL REPORTS.

The Bureau of Ships no longer requires the submission of failure reports for all equipments. Failure Reports, Performance and Operational Reports are to be accomplished for designated equipments (refer to Electronics Installation and Maintenance Book, NAVSHIPS 900,000) only to the extent required by existing directives. All failures shall be reported for those equipments requiring the use of Failure Reports.

5-2. PREVENTATIVE MAINTENANCE.

a. ANTENNA.-

(1) Since the AN/TRN-22 (XN-1) Transponder Unit has few moving parts, maintenance considerations are held to a minimum.

(2) The area of design which calls for periodical maintenance is all located in the antenna drive assembly. A periodical inspection and servicing of the antenna drive section is recommended after each 100 hours of operating time. At this time, the following area should be carefully inspected and serviced as outlined.

(a) BEARING INSPECTION AND LUBRICATION.-

1) An upper and lower bearing is utilized to rotate the pulser plate and housing assembly. Although the combined thrust and radial loads that these bearings are subjected to are very light with calculated bearing life falling over 30,000 hours, through careless handling and/or operation in dusty environment, without the radome in place, these bearings may become damaged or contaminated. Therefore the two bearings should be visually inspected for any abnormal or excessive end play or radial play. This can be accomplished mainly by feel and common sense. If this condition is found, the bearings should be replaced.

2) Lubrication of the bearings should also be accomplished at this time. For this particular bearing the manufacturer recommends lubricating with an excess of MIL-L-6085A instrument oil.

(b) MOTOR AND GEAR INSPECTION.-

1) The gear and pinion should be inspected for abnormal wear. If excessive backlash is present, either the gear and/or pinion should be replaced.

2) It should be noted that the gear is aluminum and the pinion is delrin. This design is utilized for quiet operation and dry running. It is recommended that if the gear mesh is creating abnormal noise, that a small amount of grease meeting MIL-G-3278 be applied to the pinion. This will reduce the objectional noise considerably.

3) The motor should also be inspected for any abnormal bearing wear.

4) If any part of the motor fails, the motor must be replaced, since it is a non-repairable factory-sealed unit the motor bearings need not be lubricated since these bearings are sealed and self-lubricating.

b. TRANSPONDER UNIT.- In addition to the above which concerns the servicing of mechanical parts it is advisable to perform the following electrical measurements within the same 100 hours time interval.

(1) TRANSPONDER POWER OUTPUT.-

(a) The purpose of this test is to verify that the transmitter output r-f peak power measured at the transponder carrying case external connector is not less than 100 Watts at the desired channel.

(b) TEST EQUIPMENT.-

1) Peak power calibrator, Boonton, Type 8900A and 10 db pad;

2) Bidirectional coupler, Hewlett-Packard, Model 7662;

3) Oscilloscope, Tektronix 585;

4) Two terminating loads 50 Ω;

5) Attenuator, fixed, 10 db 10 W, Weinschel, Model 10-10; and

6) Attenuator, fixed 20 db 20 W 50 Ω.

(c) TEST PROCEDURE.-

1) Connect equipment as shown in Figure 5-1;

2) Zero set the Boonton Peak Power Calibrator;

3) Set controls on the transponder as follows:

XPonder Power to ON
Ant. Power to OFF
MODE SW to OPER

4) Read peak power calibrator.

(d) If peak power reading is less than 100 W and peaking of the transponder tuning controls does not result in the needed improvement, replace final output tube.

(2) NORTH BURST DROOP.-

(a) The purpose of this test is to verify that the total droop of the north burst signal is not more than 5%.

(b) TEST EQUIPMENT.-

1) Bidirectional Coupler, Hewlett-Packard Model 766D,

2) Oscilloscope, Tektronix, 585;

3) 10 db, 10 W attenuator Weinschel Model 10-10;

4) 20 db attenuator 2 W 50 Ω;

5) 10 db attenuator 50 Ω;

6) Detector, Texscon Model CD-50 with 50 Ω load; and

7) Two terminating loads 50 Ω.

(c) TEST PROCEDURE.-

1) Connect equipment as shown in Figure 5-2;

2) Set controls on the transponder as follows:

XPonder Power to ON
Ant. Power to ON
MODE SWITCH to OPER

3) Adjust oscilloscope controls to view one complete north burst at a sweep rate convenient to determine the droop.

(d) If total droop exceeds 5% and peaking of the transponder tuning controls does not result in the needed improvement, replace final output tube.

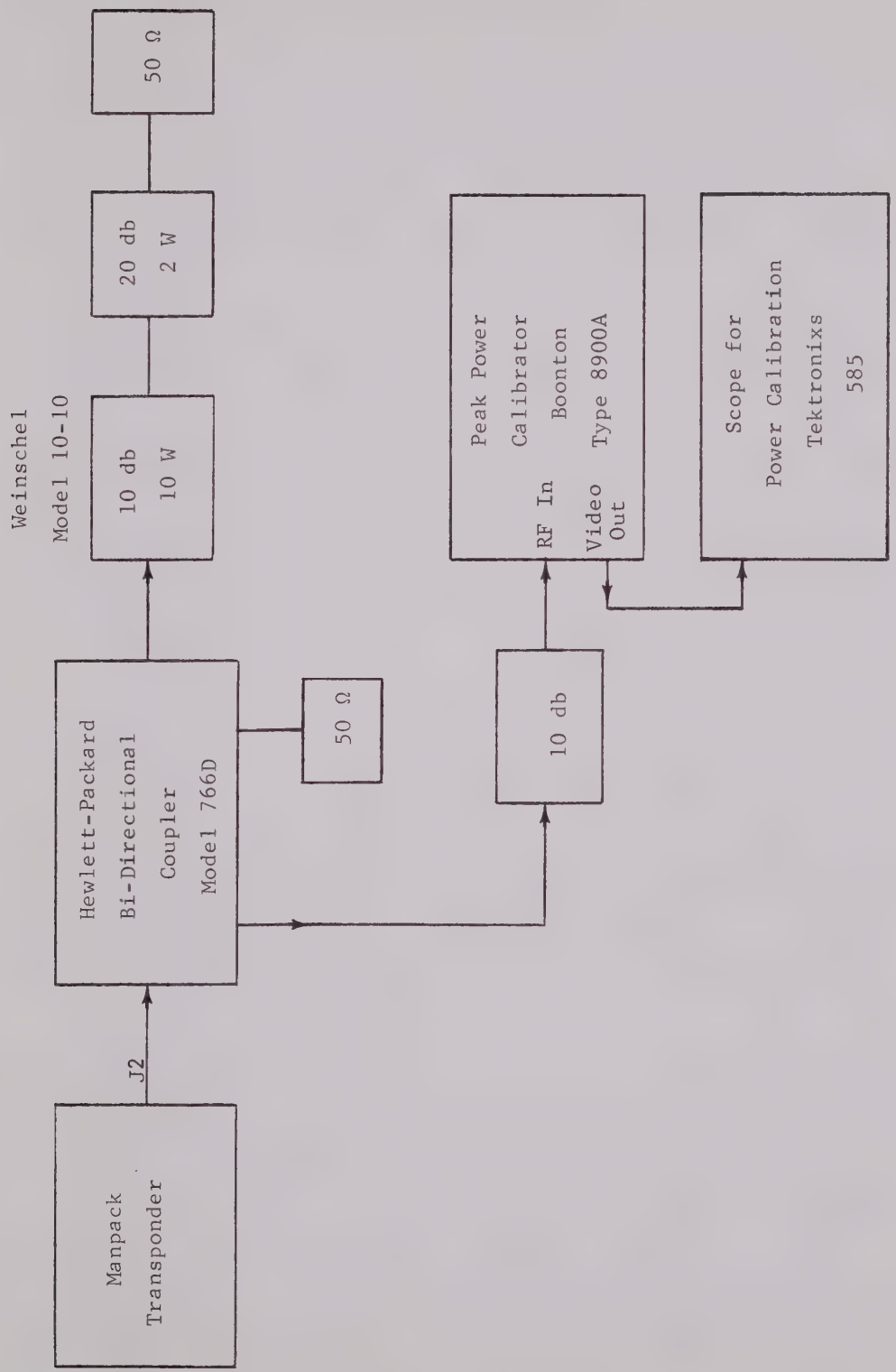


Figure 5-1. Test Setup for Transponder Output Power Measurement

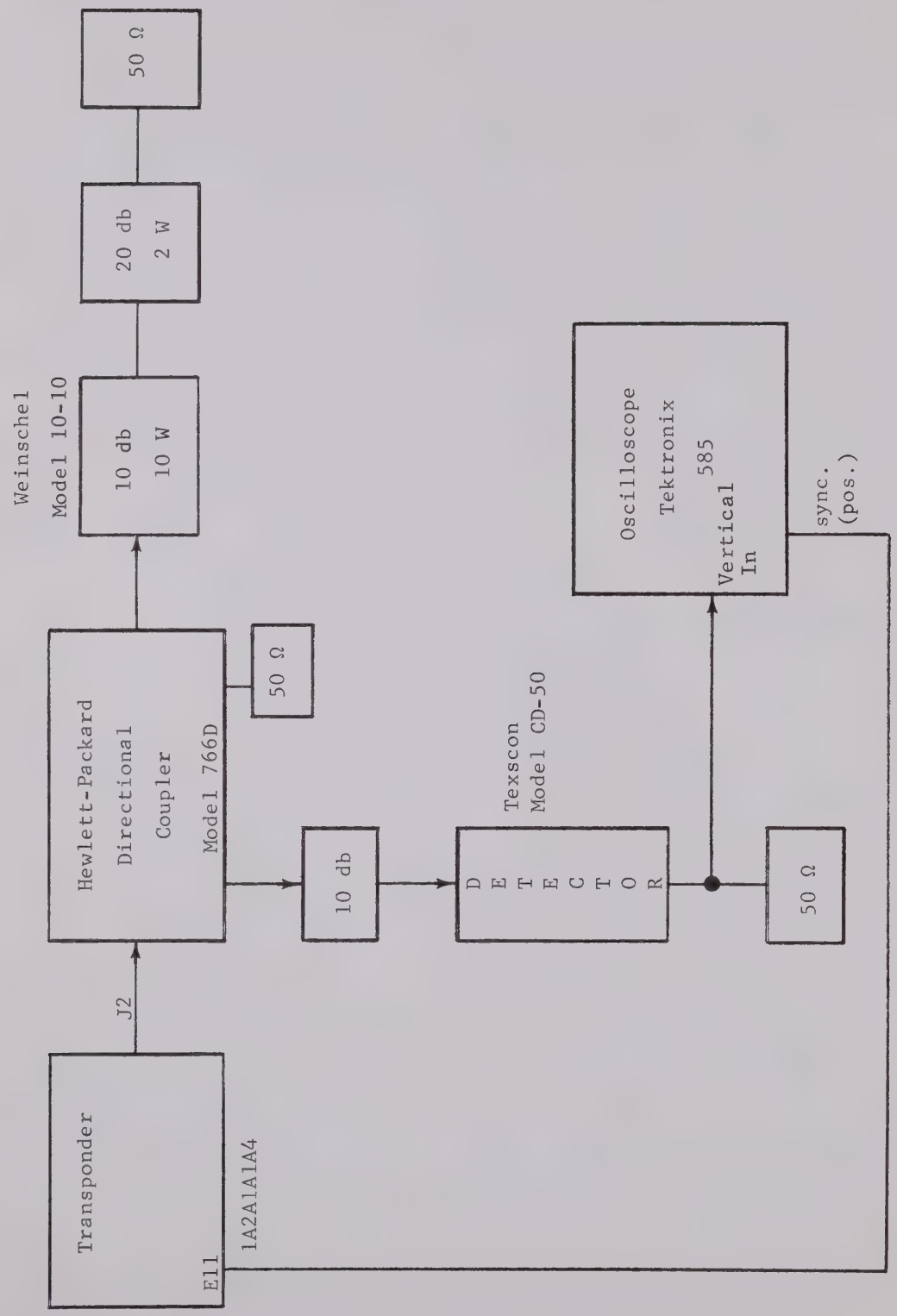


Figure 5-2. Test Setup for North Burst Droop Measurement

Note

When measuring droop, check to see if the detector operates in the linear detection range as discussed in 4-12c page 4-52.

5-3. REMOVAL, REPAIR, AND REPLACEMENT OF PARTS, SUBASSEMBLIES, AND UNITS.

Caution

All power must be disconnected before removal of any assemblies.

a. REMOVAL.-

(1) REMOVAL OF TRANSPONDER FROM THE CASE.-

(a) Unfasten the two turn latches to remove front cover;

(b) Lower front cover and remove it from the hinges;

(c) Unfasten the four captive panel screws;

(d) Remove all cables from the back of the transponder; and

(e) While holding the case remove the transponder from the case.

(2) REMOVAL OF THE CARD RACK.-

(a) Remove the four screws holding the card rack in place;

(b) Lift card rack straight up from its mounting position; and

(c) Place it on some insulating material on top of the transponder or off to the side of the unit.

(3) REMOVAL OF THE MULTIPLIER CHAIN.-

(a) Record the dial readings of the amplifier cavities and the preselector;

(b) Remove the six pins from the dials of the amplifier cavities and preselector. Place them in the same order on the bench;

(c) Loosen the set screws of the dials with an allen wrench;

(d) Remove the dials placing them on the bench in the same order as they were mounted on the front panel;

(e) Remove the five large flat-head screws from the front panel;

(f) Put something under both sides of the transponder near the front about one quarter inch high, such as a pencil, to support the transponder and remove the front panel about two inches away from the unit;

(g) Remove the two cables from the output of the Multiplier Chain at J1 and J3;

(h) Note or label which color of wires are soldered to which points before unsoldering them from the Multiplier Chain;

(i) Remove the detector Tee at J2;

(j) Remove the six smaller flat-head screws from the front panel which holds the multiplier chain in place; and

(k) Remove Multiplier chain from front panel.

(4) REMOVAL OF THE PRESELECTOR AND TUBE AMPLIFIER CAVITY ASSEMBLY.-

(a) Follow paragraph (3), (a) through (g), for removal of the front panel and remove coaxial cables with

connectors from this assembly;

(b) Unsolder the filament leads from the power supply terminals;

(c) Unsolder the thousand volt lead and the two adjacent ground leads from the power supply terminal;

(d) Unsolder the twenty-five volt lead which goes to the preselector assembly from the power supply terminals;

(e) Remove the two large flat-head screws from the back of the transponder holding the preselector assembly;

(f) Remove the three flat-head screws from the upper left side of the transponder holding the preselector assembly;

(g) The preselector assembly is now loose except for one coaxial cable which goes from the card rack to the tube cathode biasing circuit mounted on the assembly; and

(h) Before unsoldering this cable with ground lead remove the biasing circuit with the two screws to gain access.

(5) REMOVAL OF THE RECEIVER.-

(a) With the card case removed and while facing the front panel, place the right-hand side of the transponder down on the bench;

(b) Remove the three screws from the interlock switch nearest to the bench;

(c) Remove the four flat-head screws from each end of the bottom panel;

(d) Remove the bottom panel far enough to disconnect the three cables from the receiver;

(e) Push the interlock switch, nearest to the bench, in while removing the bottom panel with the receiver mounted to it; and

(f) Remove the six flat-head screws from the bottom panel which holds the receiver.

(6) REMOVAL OF THE POWER SUPPLY.-

(a) Label all wires with reference to the power supply terminals and unsolder;

(b) Remove the five flat-head screws from the outside edge of the power supply at the back of the transponder;

(c) Label and disconnect remaining wires at the bottom, and

(d) The power supply unit may now be removed from the transponder.

Note

Do not service power supply without loading the various sources. See under "Trouble Shooting".

b. TUBE REPLACEMENT.-

(1) DISASSEMBLY PROCEDURE.-

(a) Remove preselector and Tube Cavity assembly by following the procedure as outlined in paragraph (4), (a) through (h);

(b) Remove the capacitor and bracket with the associated screws and wires from this assembly;

(c) Remove the coaxial cables from the preselector;

(d) Remove the four

screws on the corners of the preselector before removing the preselector;

(e) Remove the three screws of the tuning shaft end of the housing and pull out the tuning assembly;

(f) Unsolder the cathode wire from the cathode bias circuitry;

(g) Remove the R-F cable from the input connector;

(h) Remove the R-F input connector probe by loosening the two set screws in the collar of the tube housing;

(i) Remove the threaded lock ring from input end of housing;

(j) Carefully measure and recorddepth of tube assembly in the housing on the input end;

(k) Remove the tube assembly from the housing by unscrewing it counterclockwise until the threads disengage;

1) Turn the tube assembly slightly off center line and rotate it while the grid contact spring is being withdrawn through the threaded end of the housing.

2) Do not take it too far off center or force it as this may break the ceramic housing of the tube.

(l) Remove the three screws fastening the threaded end plug to tube assembly;

(m) Remove the fingered anode line by applying twisting pressure with a screwdriver under one side, cock it off center and it will snap off;

(o) With a thermo gun, localize heat to remove in the following order:

1) Tube adapter;

2) Grid flange; and

3) Tube from cathode lining.

(p) With a soldering iron, remove heater terminal leads.

(2) ASSEMBLY PROCEDURE.-

Notes

Concentricity of all contacting surfaces should be within .005 Total Indicator Runout (TIR) to prevent tube breakage in assembly. This can be achieved by use of alignment fixture.

Close visual inspection should be made after each step.

For clarification reference is made to tube assembly drawings, Figures 5-3 and 5-4.

(a) Solder heater leads to terminals with 60/40 solder;

(b) Place end of the cathode line away from tube in suitable heat sink holder;

(c) With heat from a thermo gun localized as much as possible, solder parts in place in the following order with 60/40 solder;

1) Tube to cathode line;

2) Grid flange; and

3) Tube adapter.

(d) Clean all parts thoroughly;

(e) Fasten thread end plug to cathode line with three screws and insulators and lockwashers and mica by-pass insulator. Check this insulation after assembling with an ohmmeter;

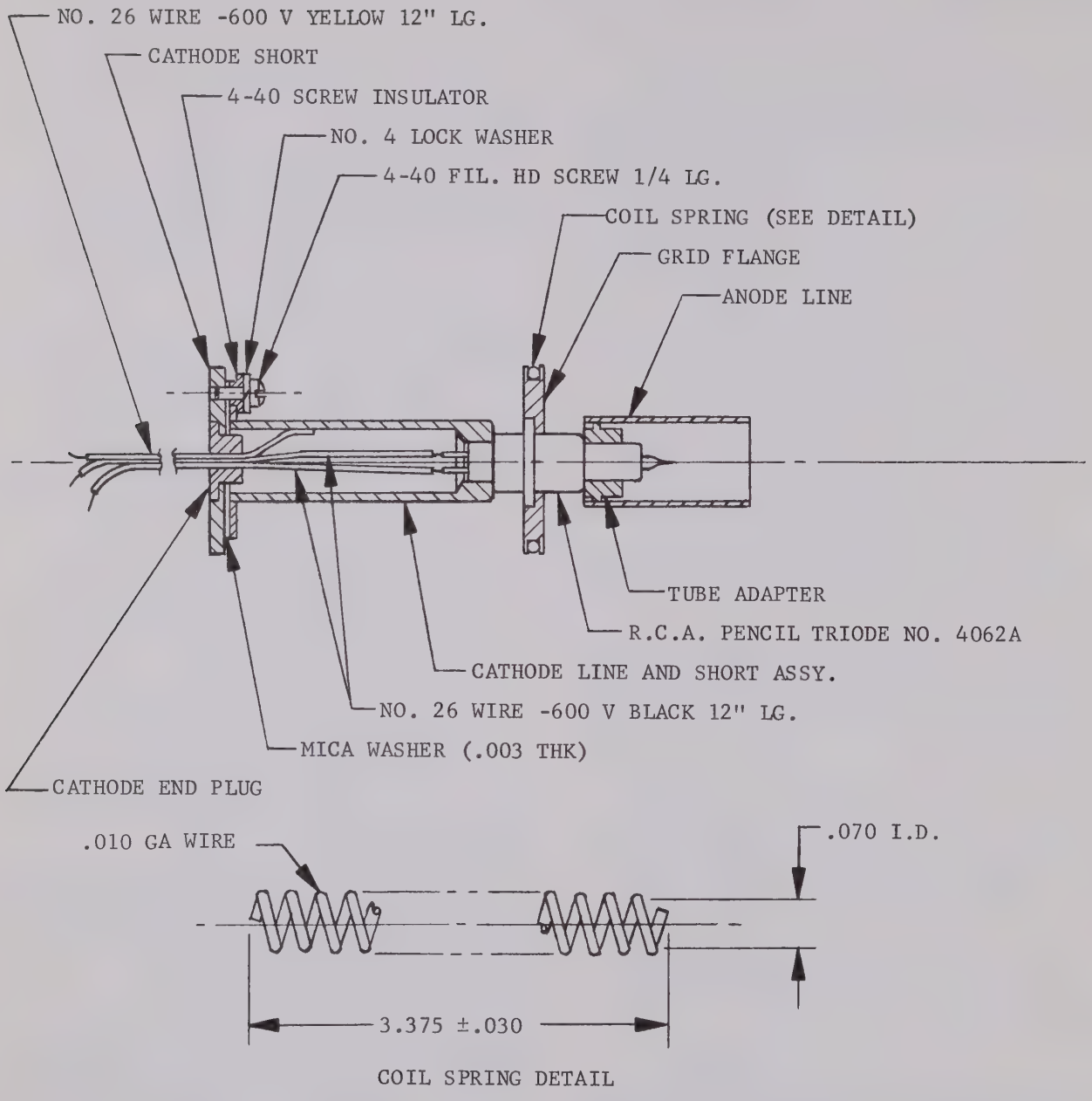
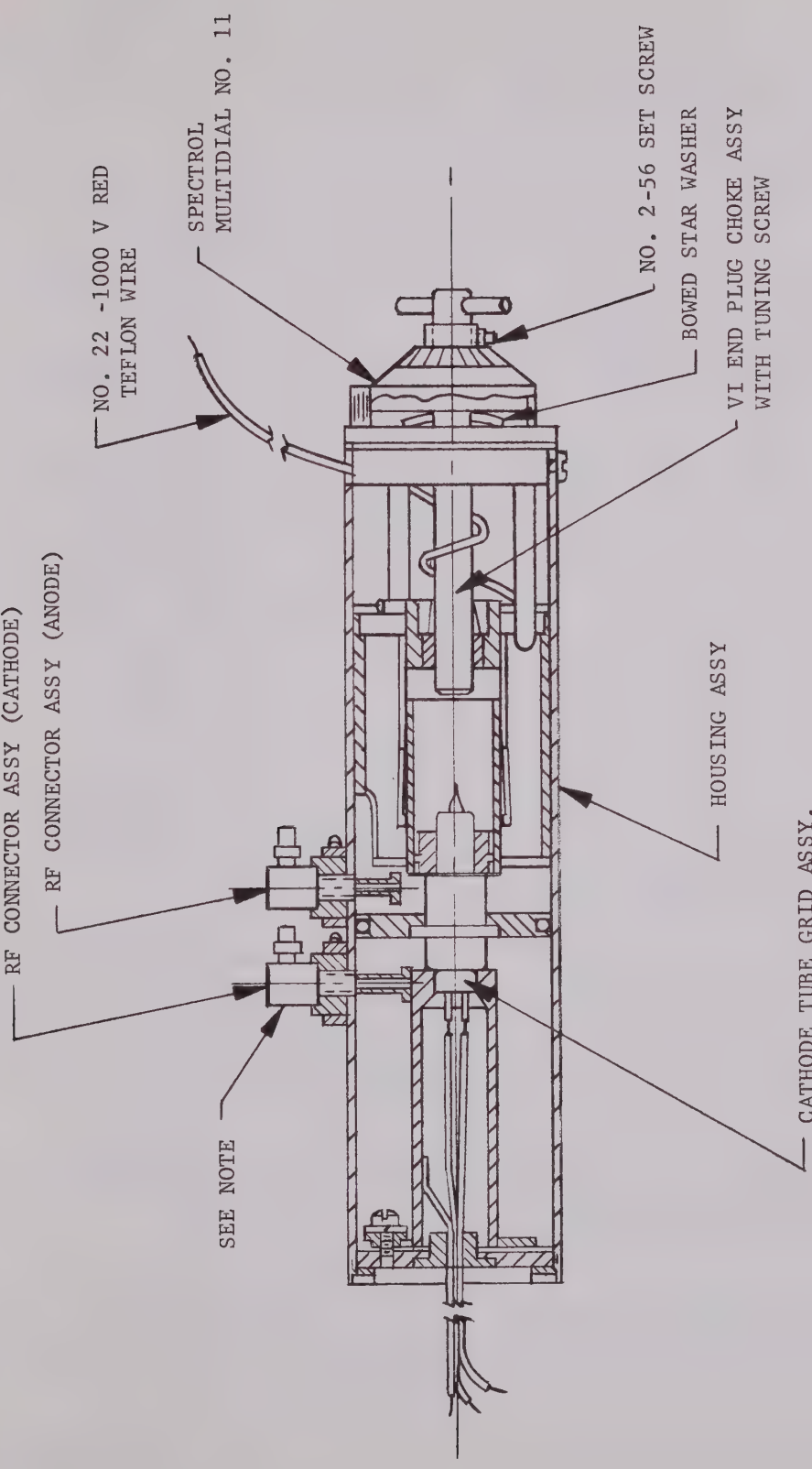


Figure 5-3. Cathode-Tube-Grid Assembly



NOTE: SHOWN OUT OF TRUE POSITION FOR CLARITY

Figure 5-4. Cutaway View of One Stage of the Power Amplifier

(f) Check concentricity of the grid flange and tube adapter with respect to cathode line; all should be within .005 man. T.I.R.;

(g) Replace fingered anode line making sure all fingers make tight contact;

(h) Check to see if coiled spring on grid flange is evenly spaced and not twisted. If deformation is excessive, remove spring from flange, stretch and rewind. Figure 5-3

(i) Carefully push tube assembly into the housing about one-half inch before the threads engage;

(j) Replace the tuning assembly in the other end;

(k) Engage the tuning assembly onto the end of the tube and align properly before replacing screws in the tuning assembly;

(l) Finish installing the tube assembly by turning it clockwise in place while observing the grid contact spring through the R-F input connector hole to avoid deformation of the spring;

(m) Replace the tube assembly the same depth as was measured and recorded;

(n) Replace the threaded lock ring;

(o) Press the input R-F connector firmly against the cathode line and tighten the two set screws in the collar;

(p) Complete reassembly of preselector and tube cavities and mount again in transponder unit;

(q) Replace the dials at the same setting as they were removed. Be sure loading washers are in place and set screw tightened in counter drill spots on the shafts. Replace handle. Double check to make sure all connectors are tight;

(r) If it becomes necessary to replace worn cables and/or connectors, reference is made to Table 5-1 for proper length as these are critical; and

(s) For trouble shooting purposes the tube/preselector assembly may be operated outside the transponder unit. To maintain mechanical reference points for the dials the small substitute front panel should be used. A rigid ground should be used from this assembly to the transponder. Use of cables of a different length might result in loss of power. Only measurements with assembly mounted inside transponder unit can be considered conclusive.

(3) RECALIBRATION OF THE TUBE ASSEMBLY.-

(a) Perform power output test as described in Section 5-2, b (1) for lowest and highest frequency of band concerned;

(b) Provided the R-F output connector has not been moved or adjusted since the old tube was in operation, the new tube should tune up at the same setting without recalibrating and adjusting the output connector of this tube assembly;

(c) The tubes should put out between 100 to 150 Watts of peak power over the band;

(d) If necessary, due to slightly unbalanced performance, the R-F output connector can be adjusted for maximum power slightly off mid-band on the end of the band with the lowest power output; and

(e) A new calibration curve should be plotted for the

TABLE 5-1. CABLE LENGTHS

FROM	TO	LENGTH*	TYPE
A5J11	A5J10	5"	RG188
A5J1	A3J3	6.6"	RG188
A4J2	A3J1	6.5"	RG188
A2J2	A3J8	5.5"	RG188
A5J12	A4J1	4.75"	RG188

* of center conductor including connectors

amplifier, although if dial was reset correctly, original curve error will be slight. Check at extremes.

Note

Procedure for replacing other tubes is quite similar. On V_1, both r-f connectors must have Mylar tape over the capacitance probe. On V_2 and V_3, the input r-f connectors do not have tape on the capacitance probe.

c. REPAIR AND ALIGNMENT OF REMAINING SUBASSEMBLIES.

Note

Reference is made to Section 4, "Trouble Shooting."

5-4. ILLUSTRATIONS.

a. PARTS LOCATION ILLUSTRATIONS.-Figures 5-5 through 5-41 present maintenance parts.

b. CONNECTION DIAGRAMS.-Figures 2-5, 2-6 and 5-42 present these diagrams.

c. PRIMARY POWER SCHEMATIC DIAGRAM.-Figures 5-43 presents the primary power distribution schematic diagram.

d. EQUIPMENT SCHEMATICS.-Figures 5-44 through 5-57 present the schematic diagrams.

TABLE 5-2. TEST EQUIPMENT

QTY.	TEST EQUIPMENT
1	Peak Power Calibrator, Boonton, Type 8900A
1	Oscilloscope, Tektronix 585
1	Bidirectional Coupler, Hewlett-Packard, Model 766D
1	Video Detector, Texscon, Model CD-50 with 50 Ω Load
1	Attenuator, Weinschel, Model 10-10
1	RF SIG GEN, Montek, Model MM-705
1	Regulated Power Supply, 0 to -12 VDC, 10 m Amps
1	Attenuator 10 db 2 W with Type N Connector, 50 Ω
1	Attenuator 20 db 2 W with Type N Connector, 50 Ω
2	Termination 50 Ω, 2 W, Type N Connector
1	JFD Adjustment Tool 5284 or Equivalent

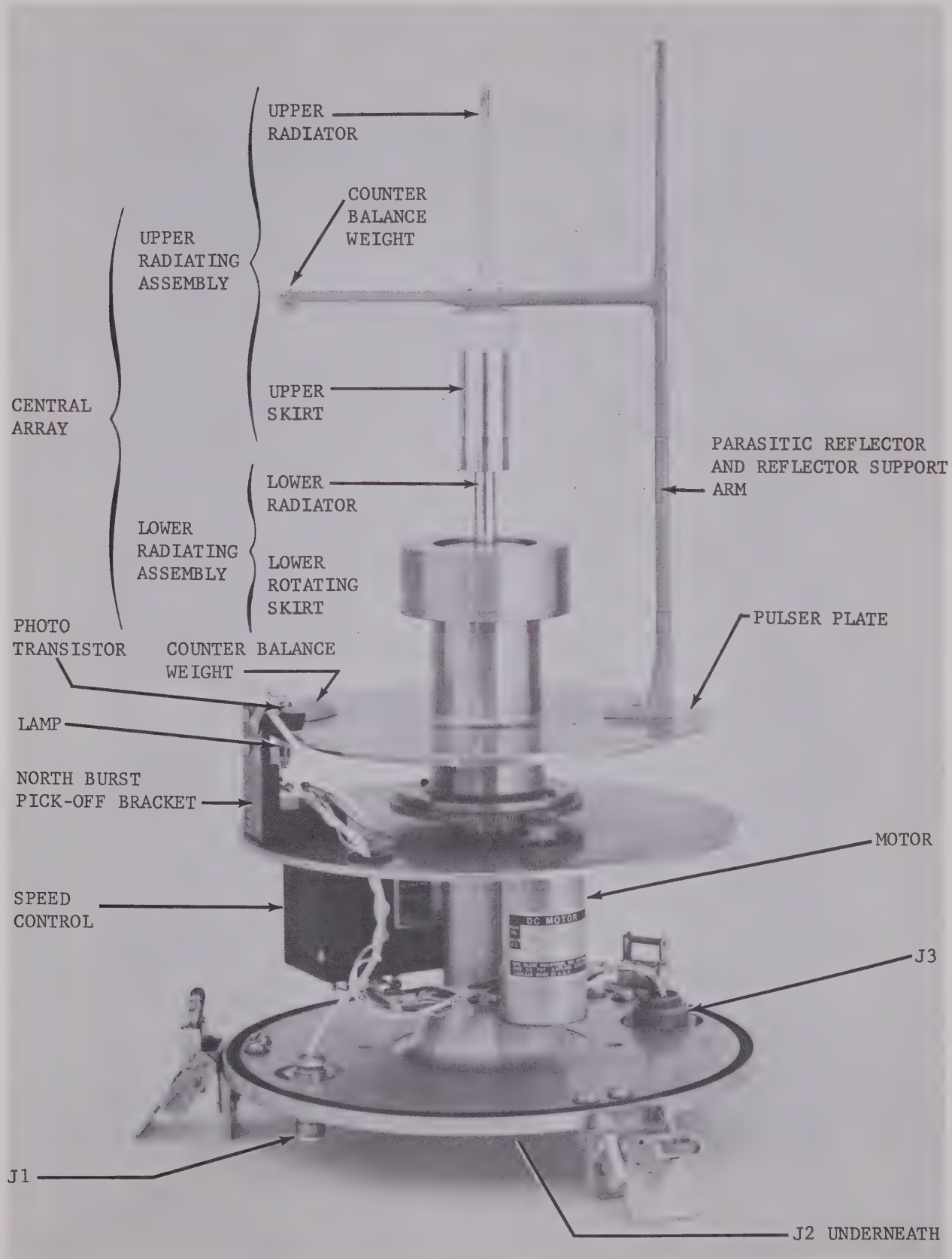


Figure 5-5. Antenna Assembly 1A1 Parts Location

CARD 1	LEVEL DETECTOR	1A2A1A1A1
CARD 2	DECODER	1A2A1A1A2
CARD 3	ARRC/CONTROL	1A2A1A1A3
CARD 4	CONTROL	1A2A1A1A4
CARD 5	MODULATOR	1A2A1A1A5

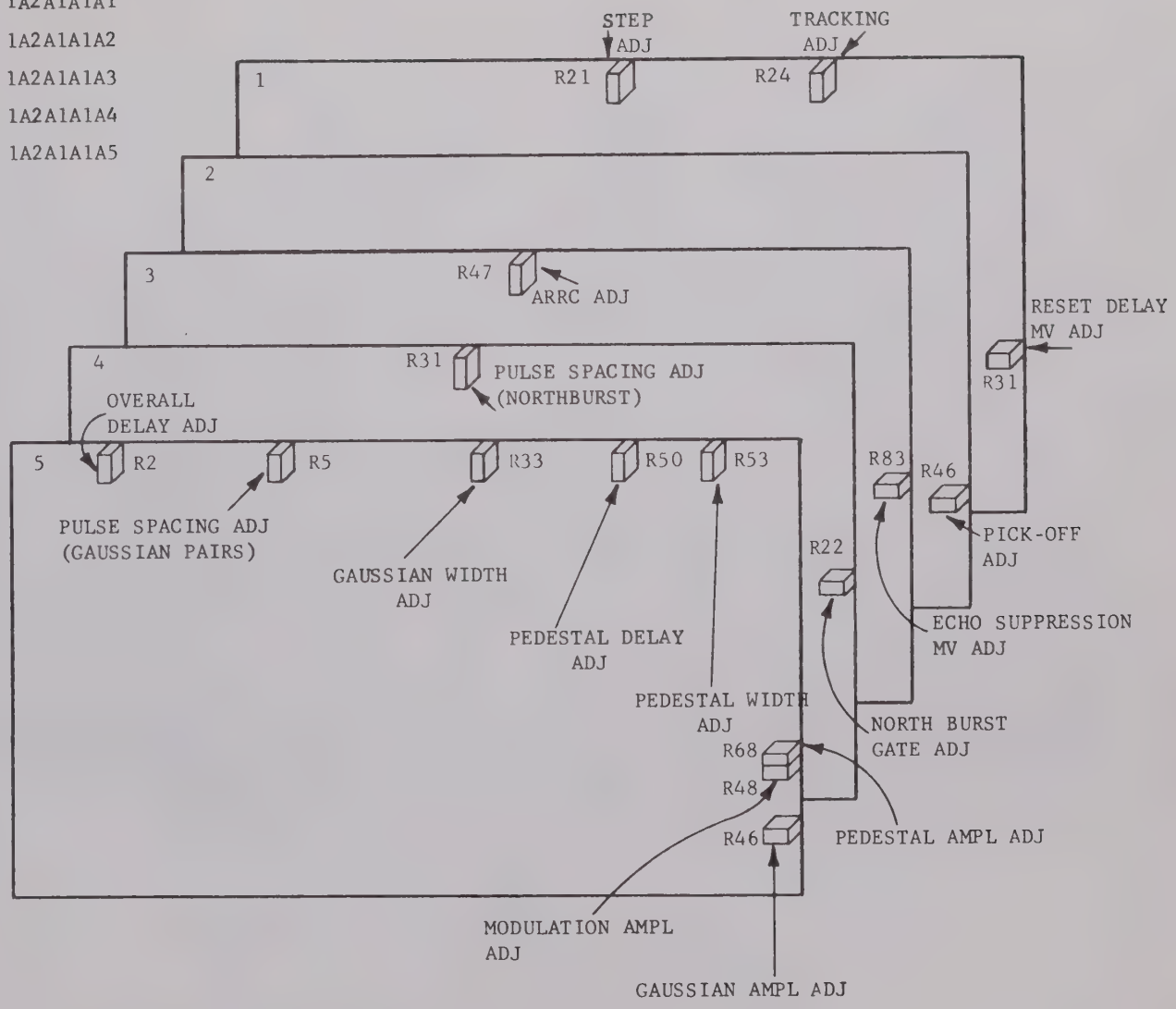


Figure 5-6. Staggered View of Circuit Boards, Showing Points for Alignment and Adjustment.

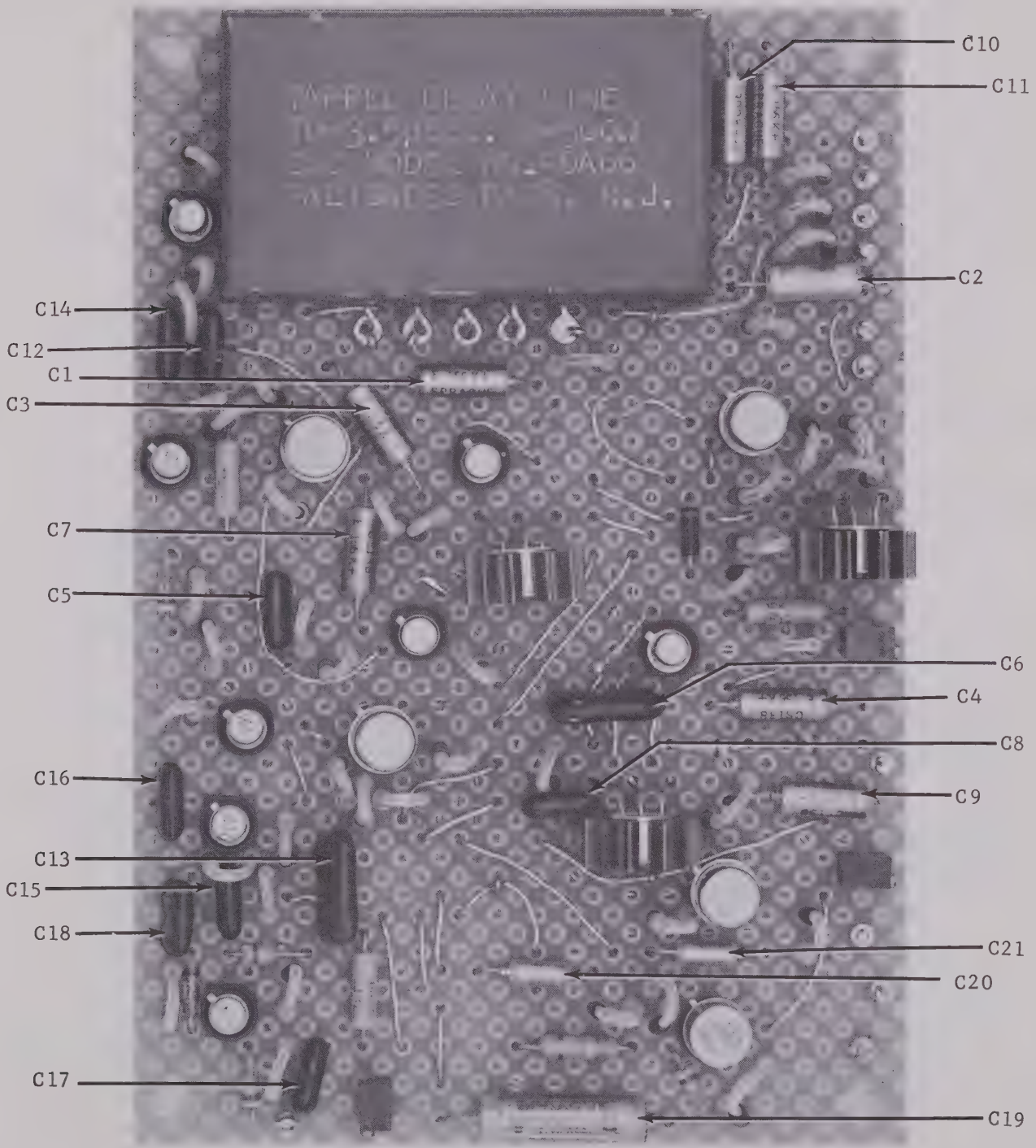


Figure 5-7. Level Detector Card 1A2A1A1A1 Showing Capacitor Locations (Including R-F Monitor)

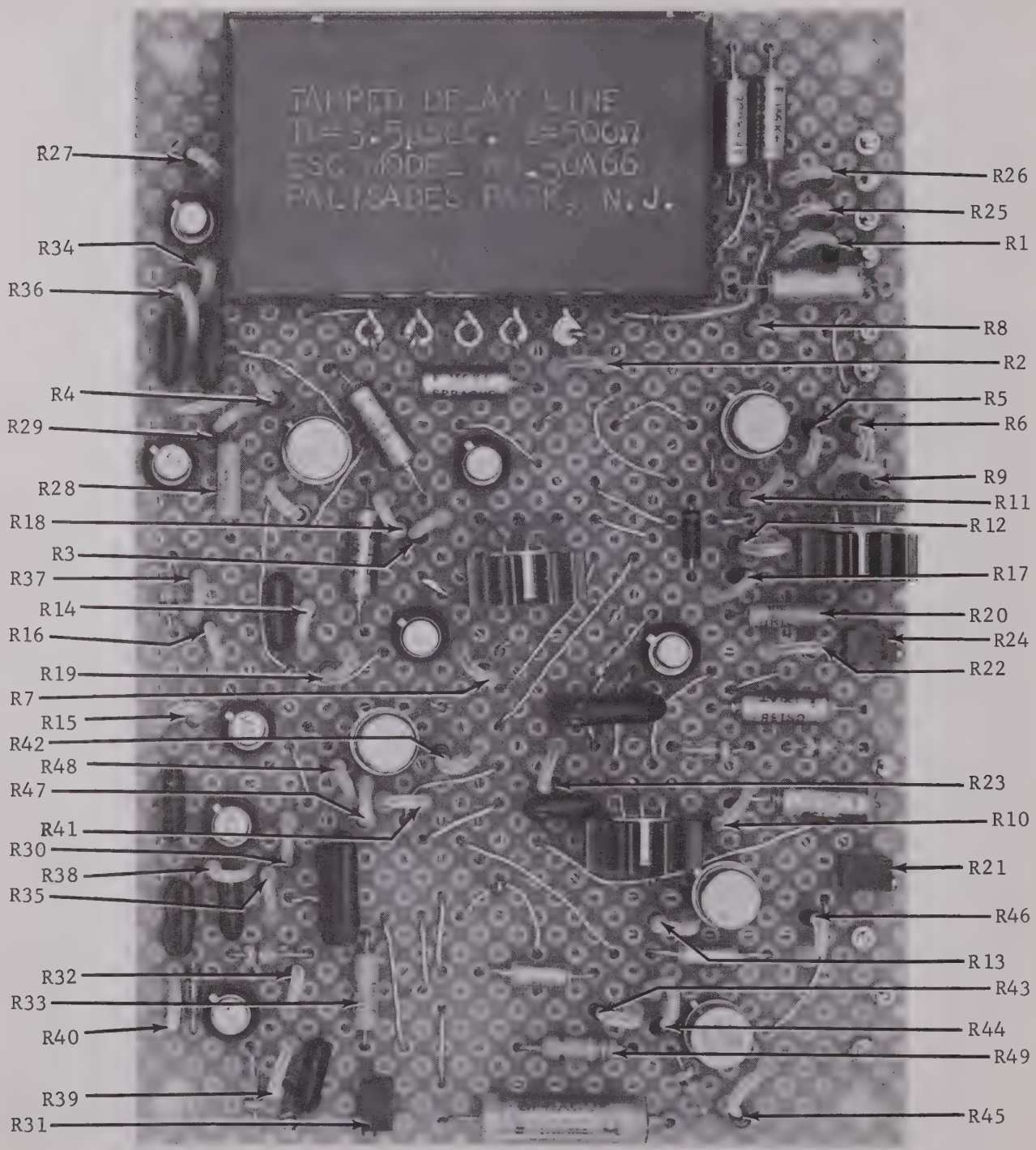


Figure 5-8. Level Detector Card 1A2A1A1A1 Showing Resistor Locations (Including R-F Monitor)

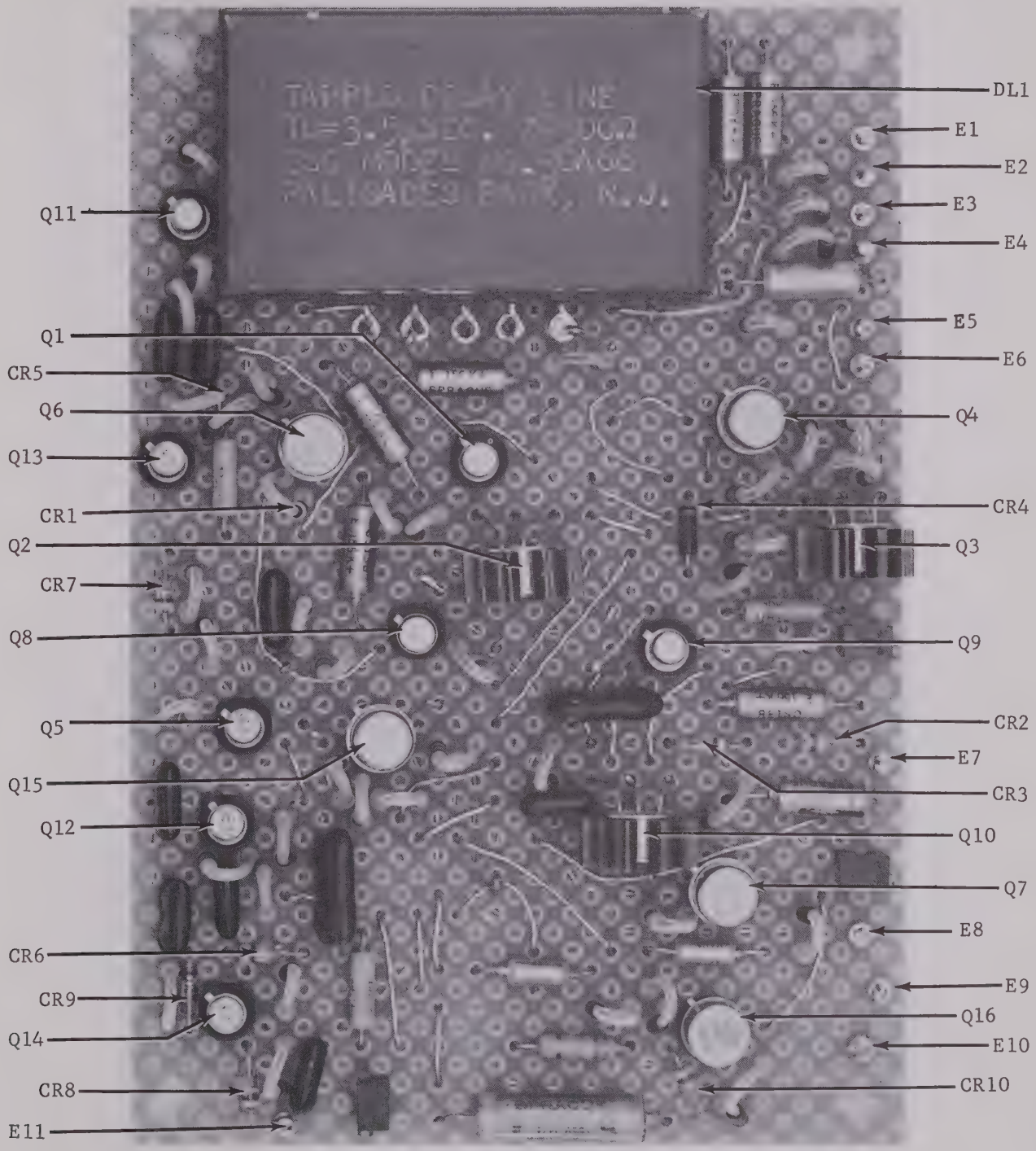


Figure 5-9. Level Detector Card 1A2A1A1A1 Showing Diode, Transistor, Terminal, and Delay Line Locations. (Including R-F Monitor)

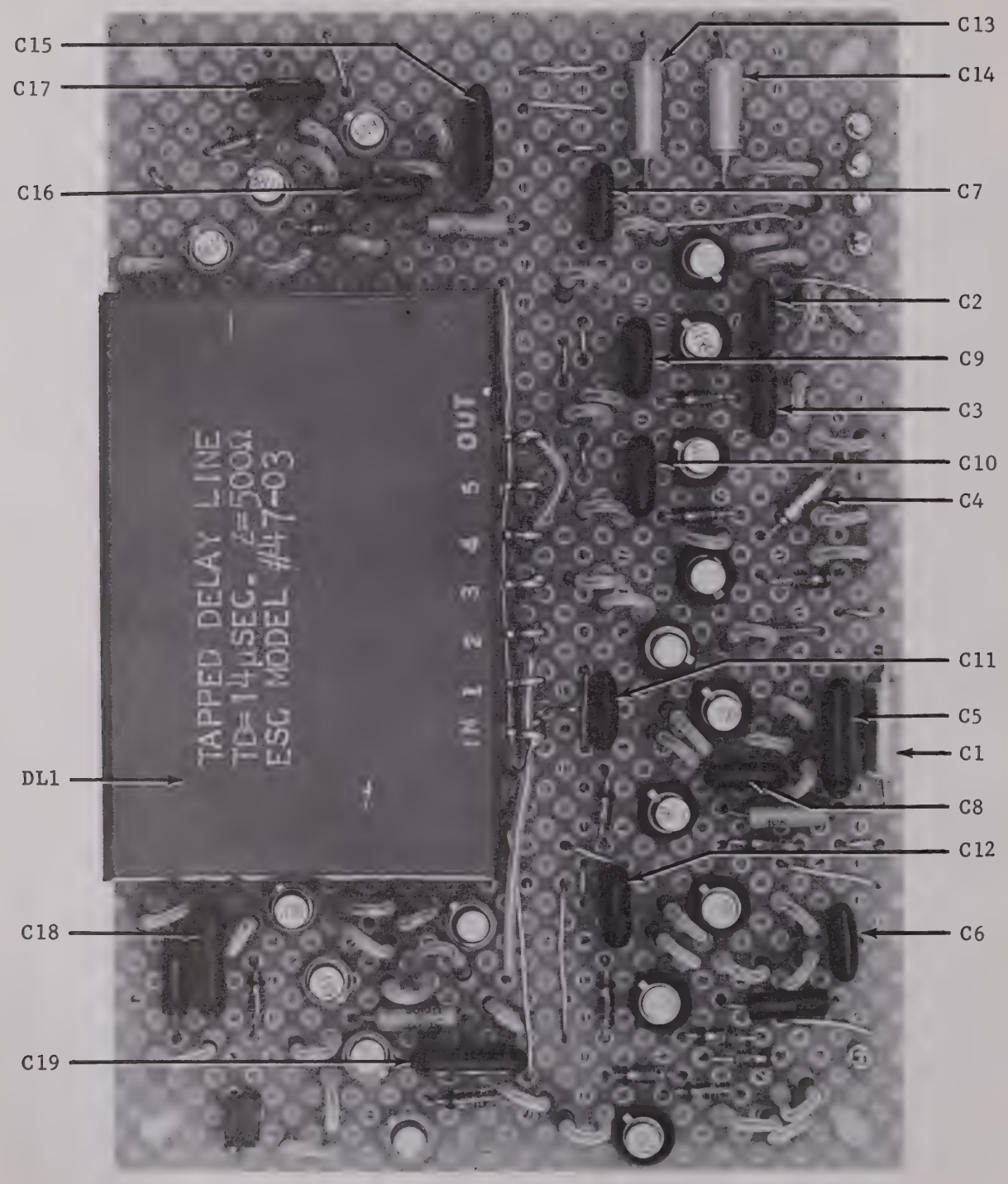


Figure 5-10. Decoder Card 1A2A1A1A2 Showing Capacitor and Delay Line Locations

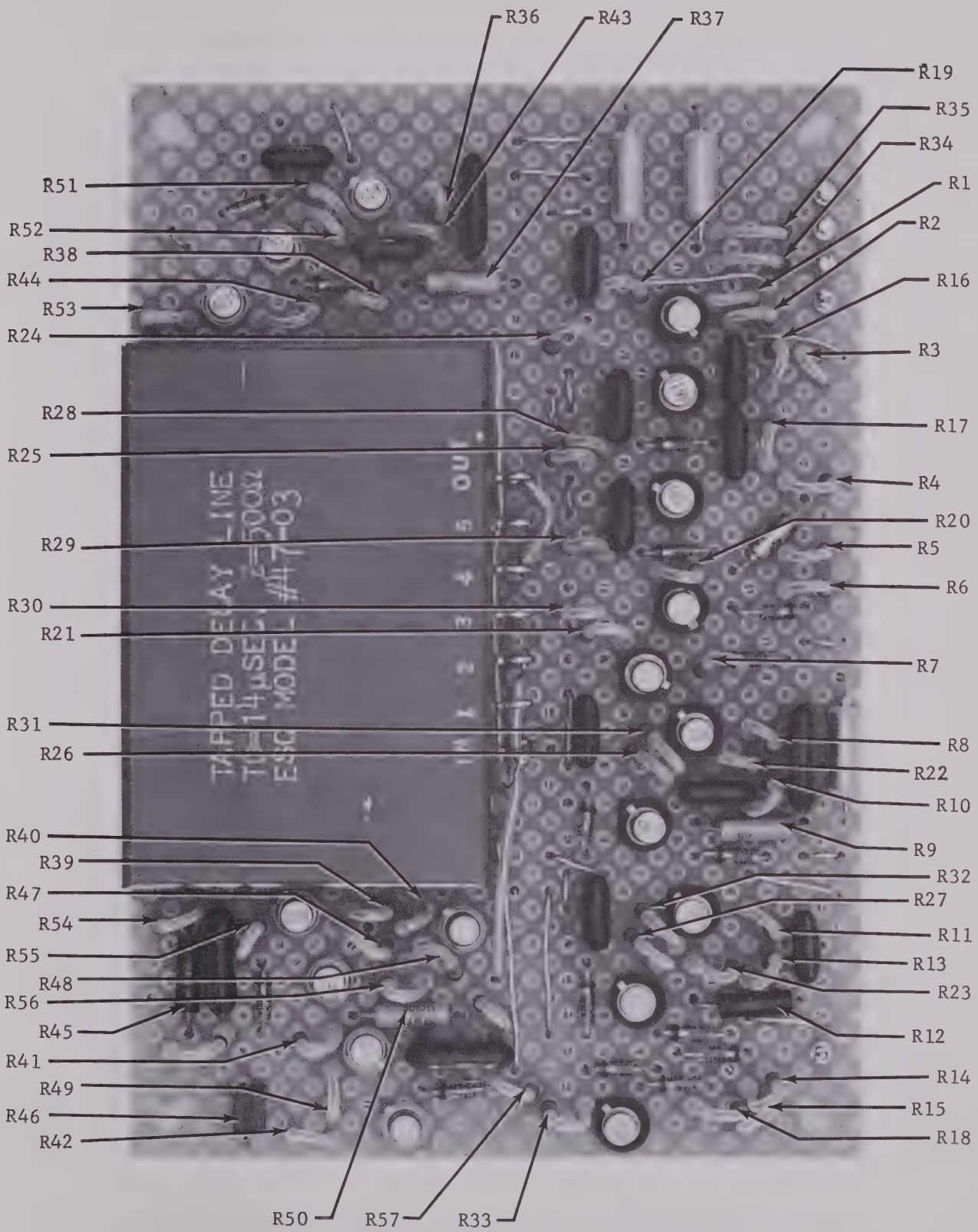


Figure 5-11. Decoder Card 1A2A1A1A2 Showing Resistor Locations

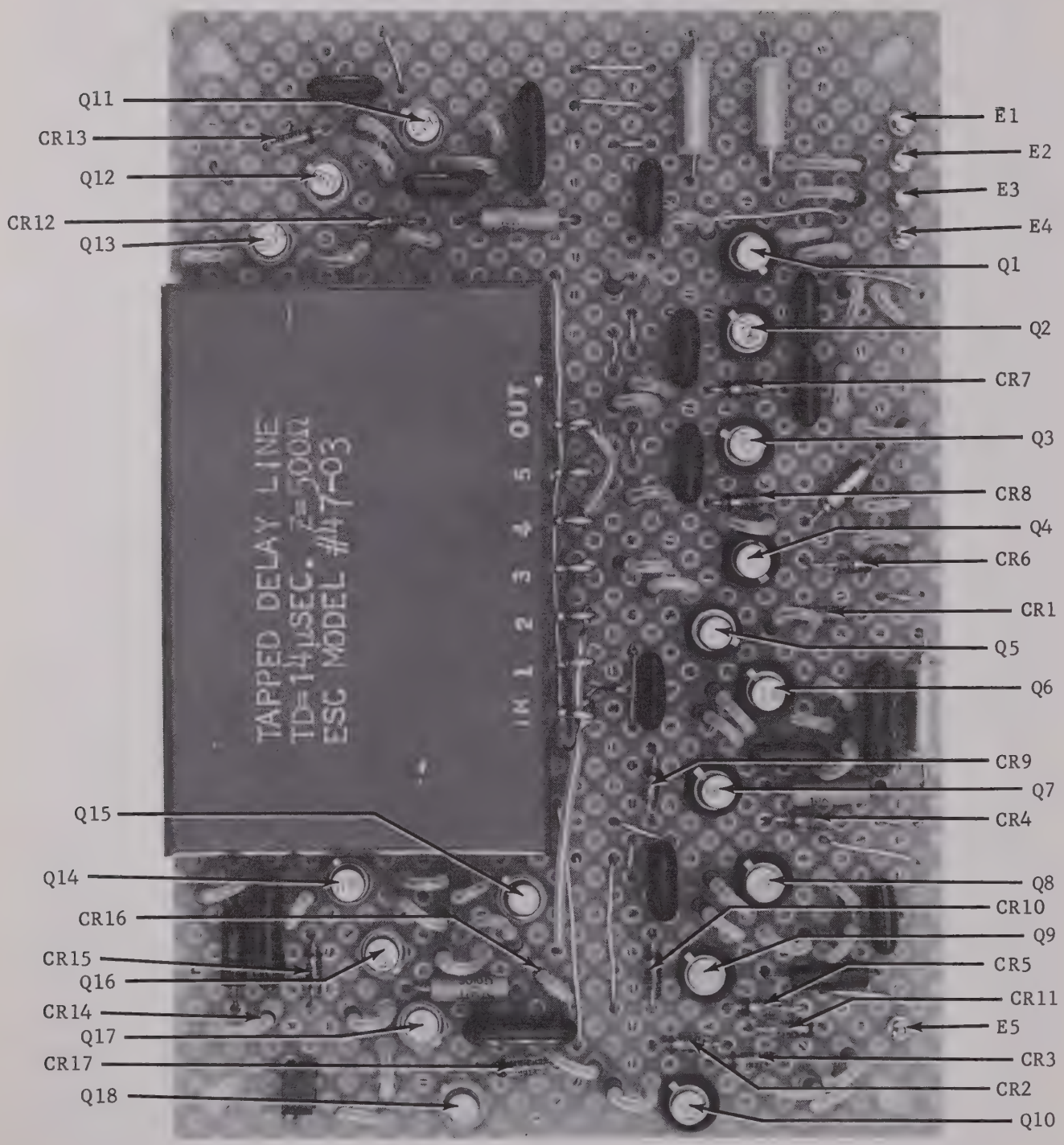


Figure 5-12. Decoder Card 1A2A1A1A2 Showing Diode, Transistor and Terminal Locations

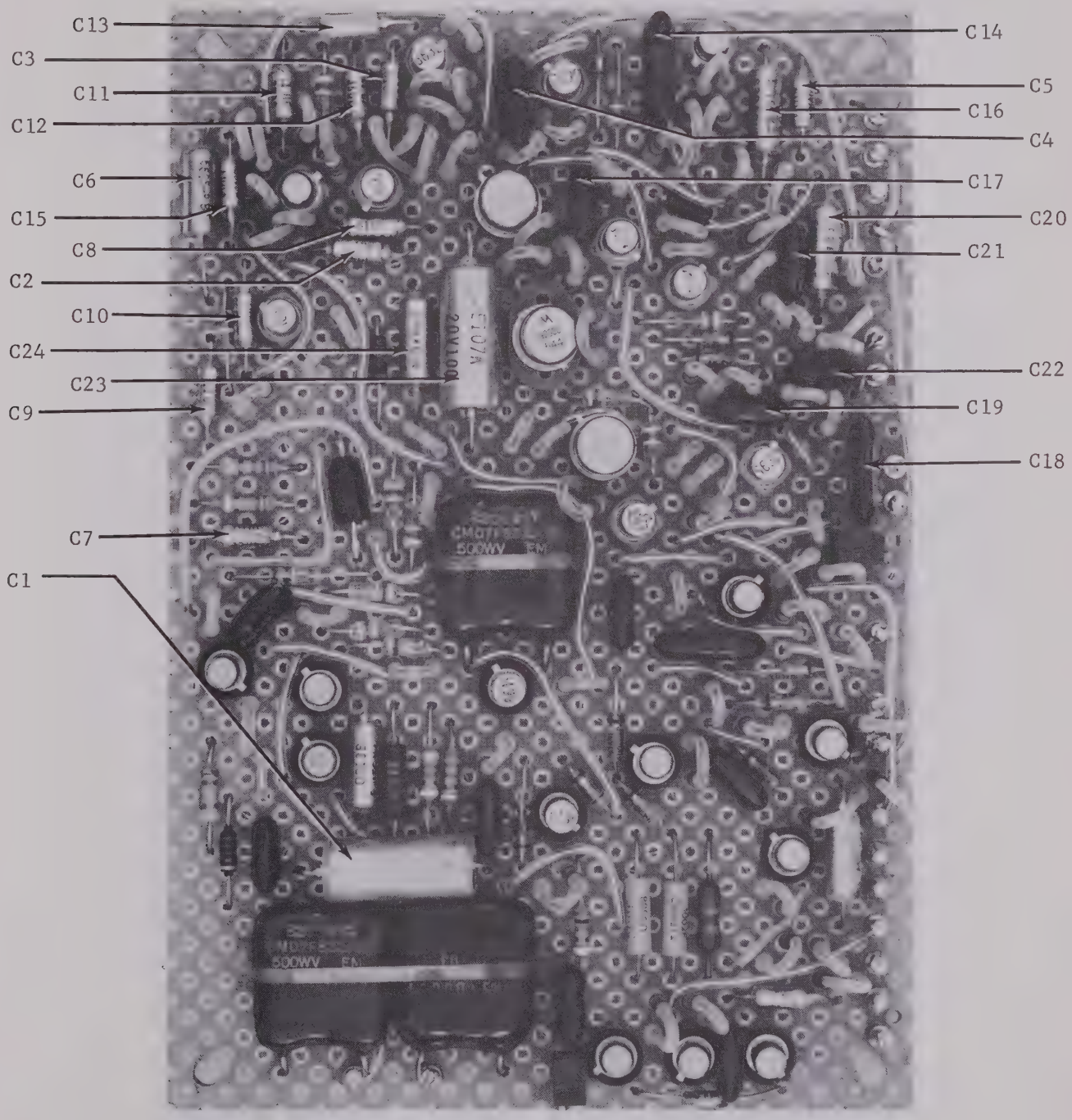


Figure 5-13. ARRC Card 1A2A1A1A3 Showing Capacitors

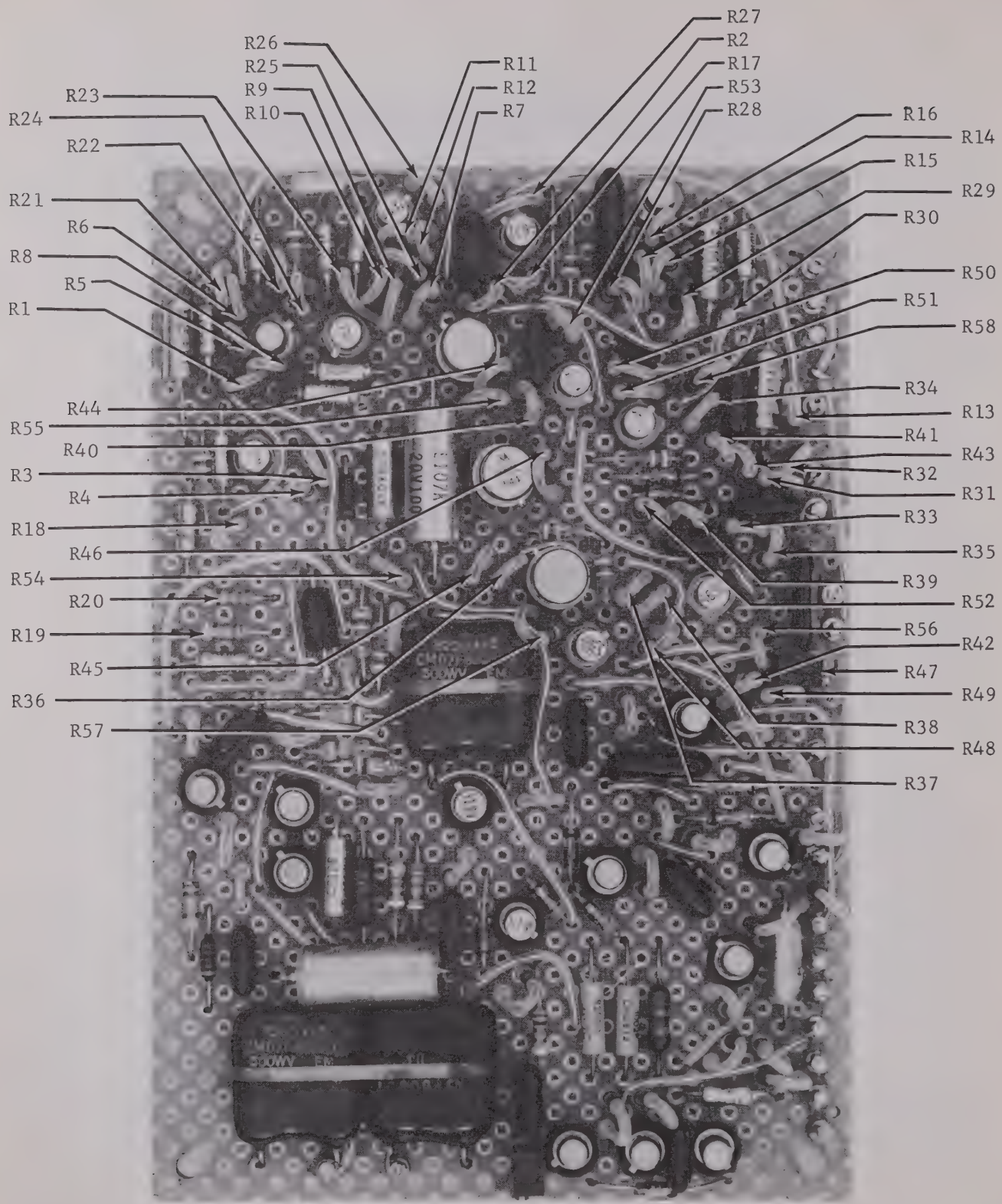


Figure 5-14. ARRC Card 1A2A1A1A3 Showing Resistors

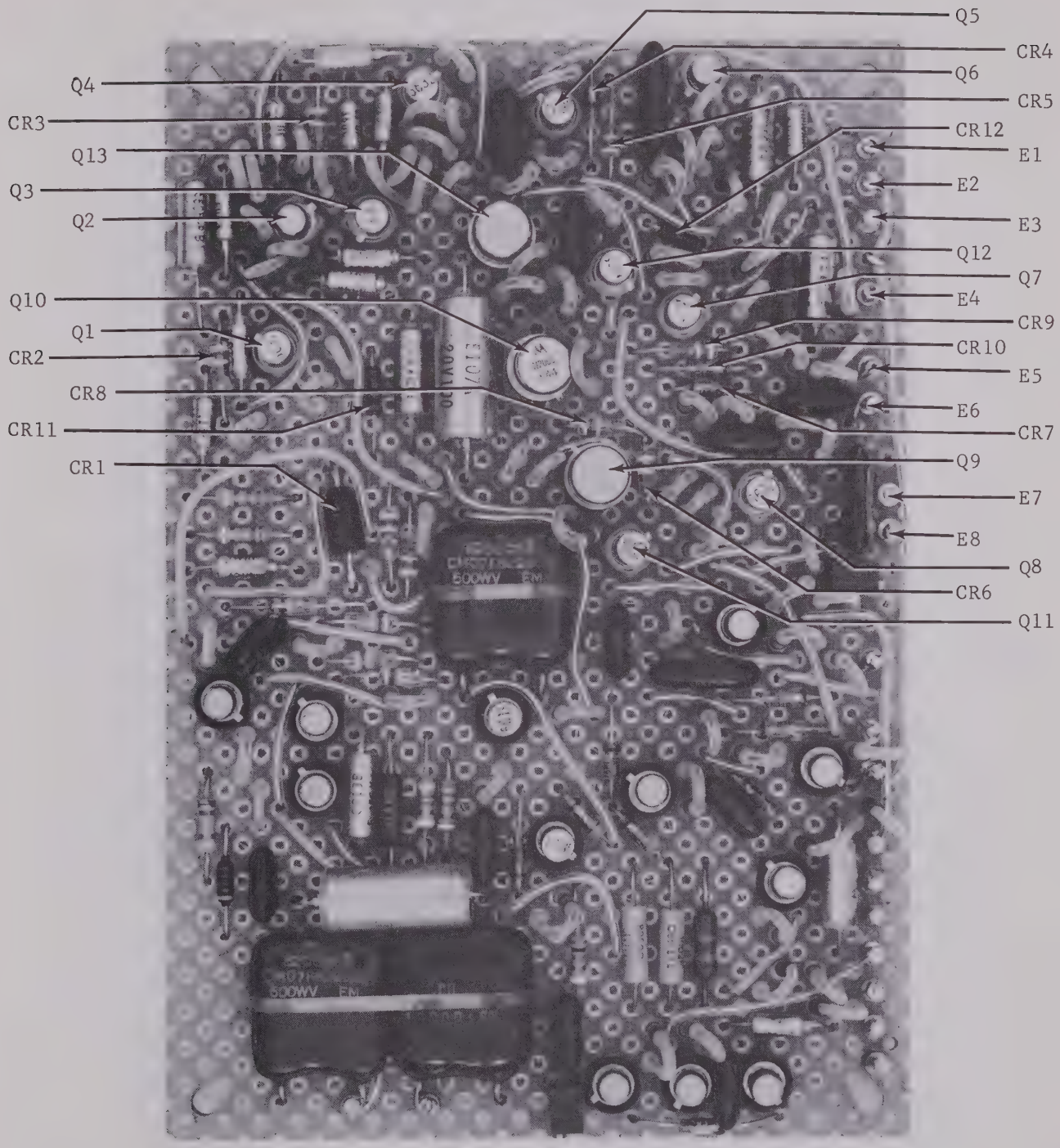


Figure 5-15. ARRC Card 1A2A1A1A3 Showing Diode, Transistor, and Terminal Locations

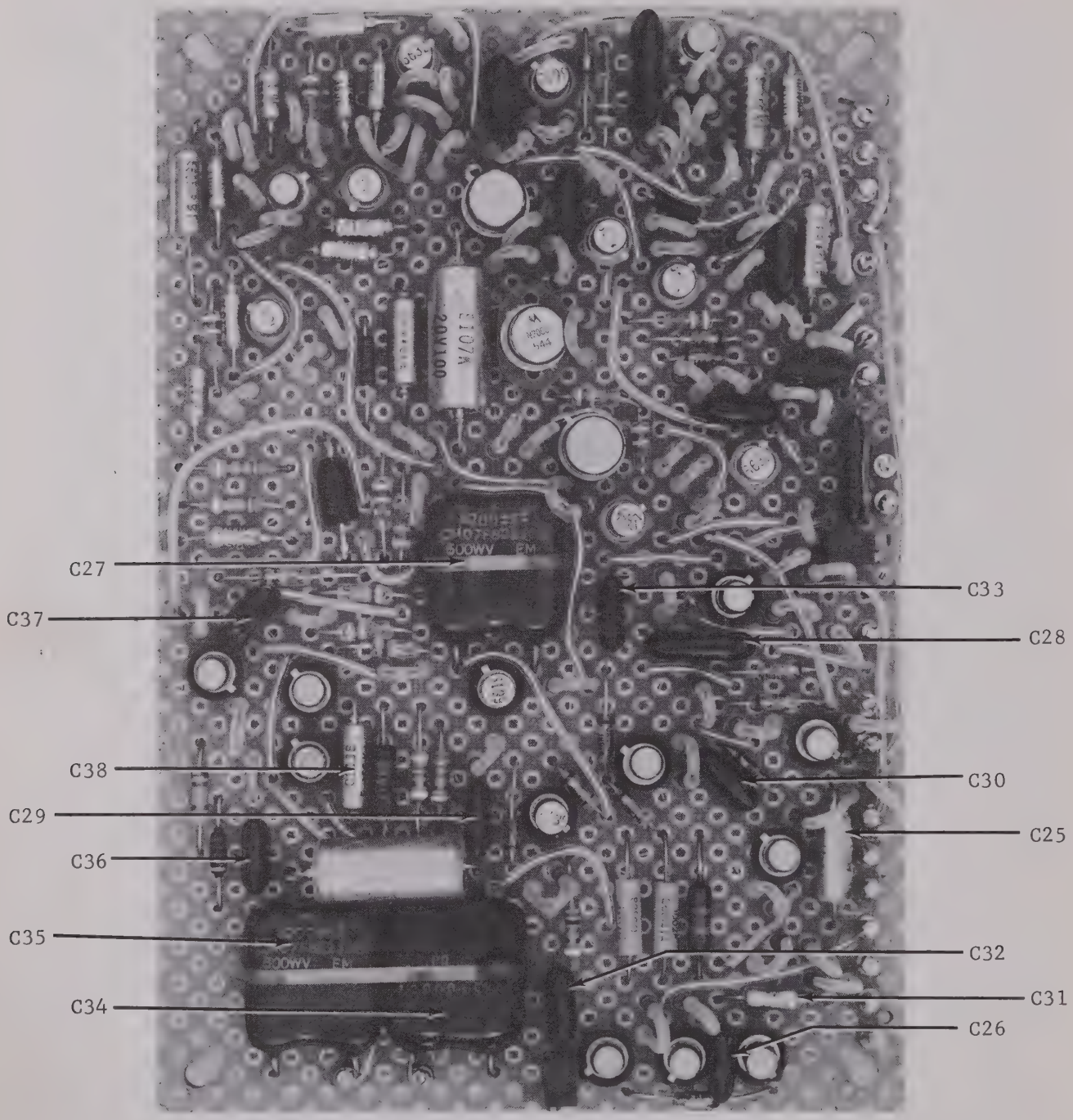


Figure 5-16. Control I Card 1A2A1A1A3 Showing Capacitors

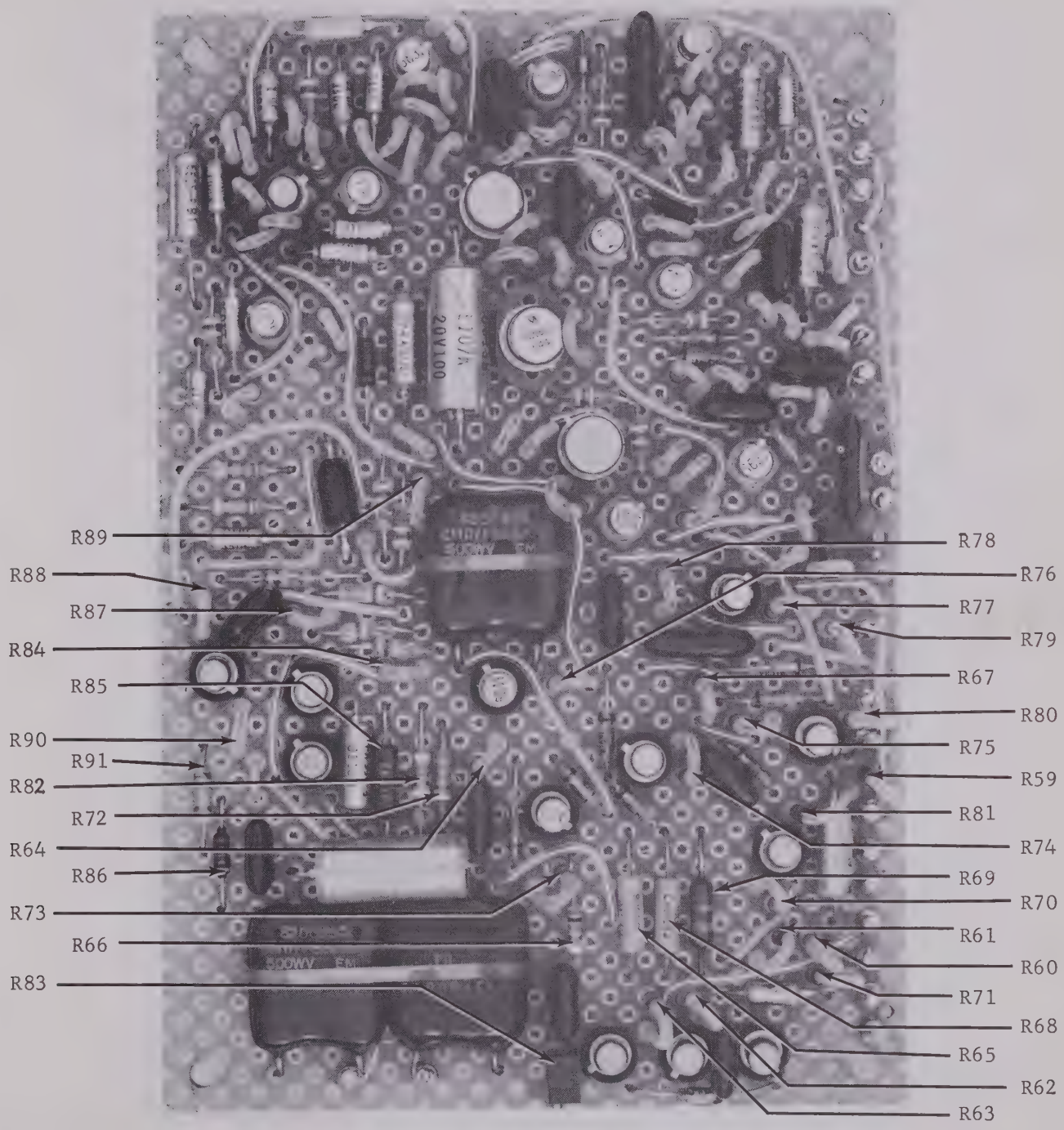


Figure 5-17. Control I Card 1A2A1A1A3 Showing Resistors

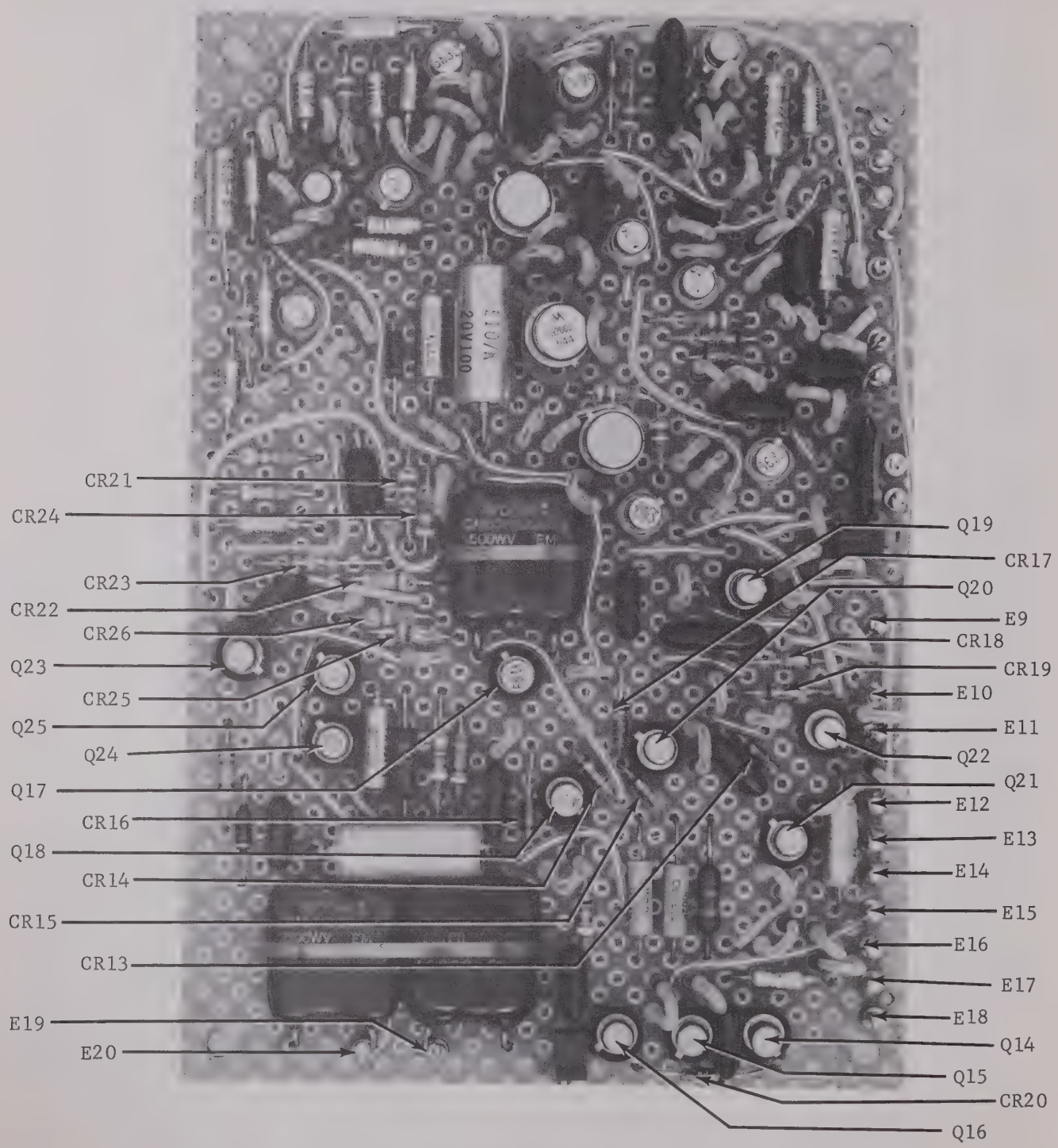


Figure 5-18. Control I Card 1A2A1A1A3 Showing Diode, Transistor, and Terminal Locations

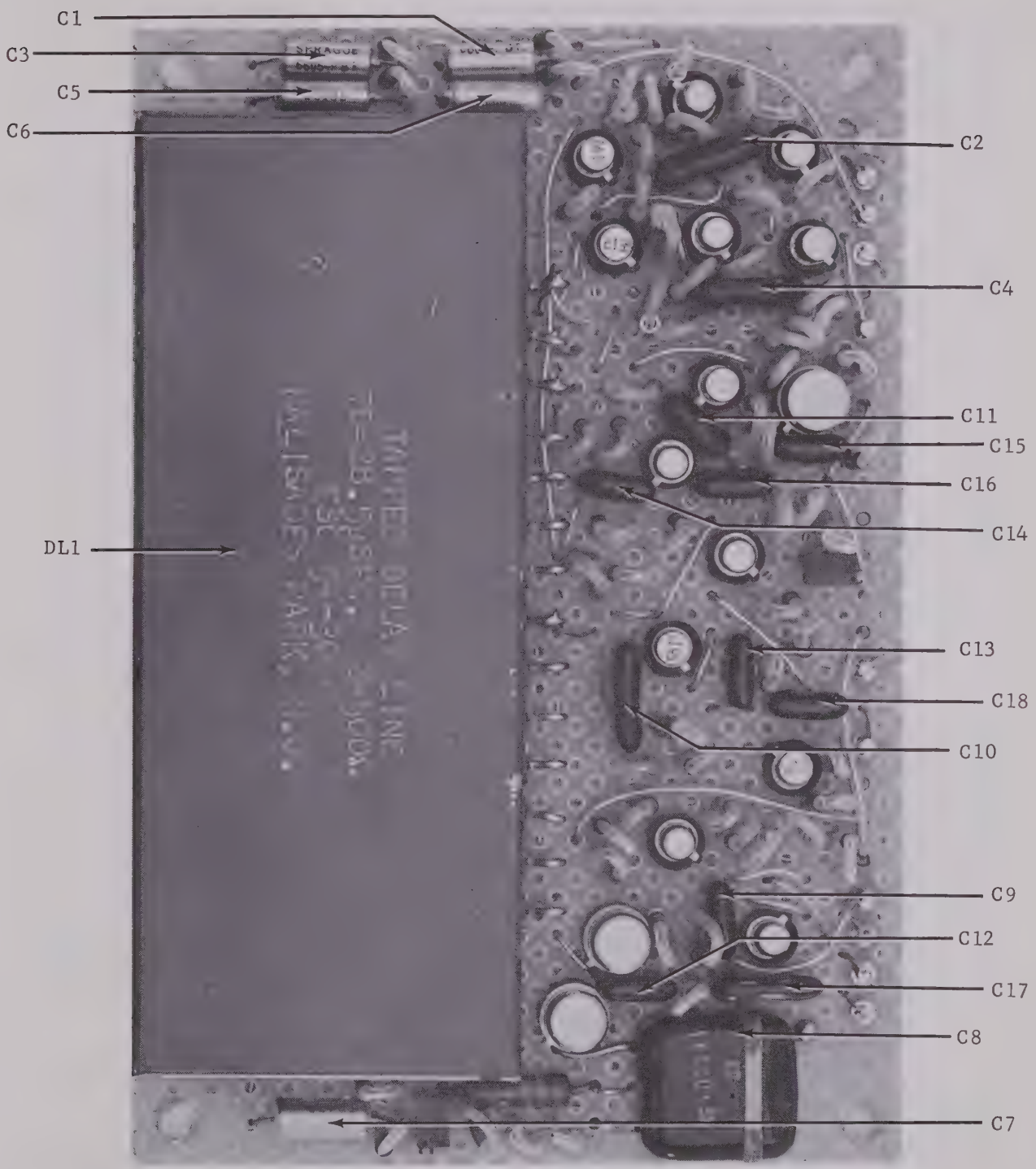


Figure 5-19. Control II Card 1A2A1A1A4 Showing Capacitor and Delay Line Locations

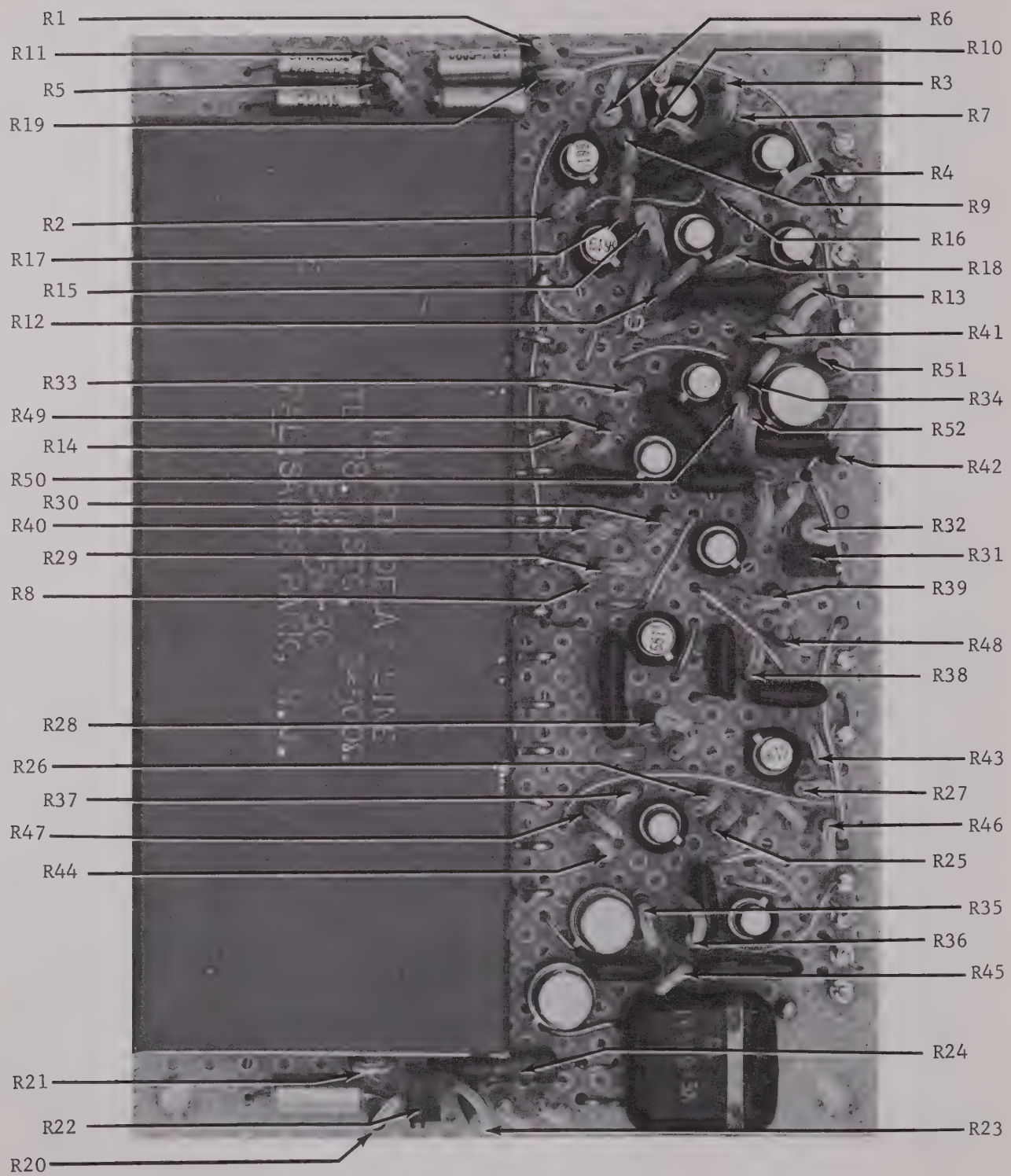


Figure 5-20. Control II Card 1A2A1A1A4 Showing Resistors

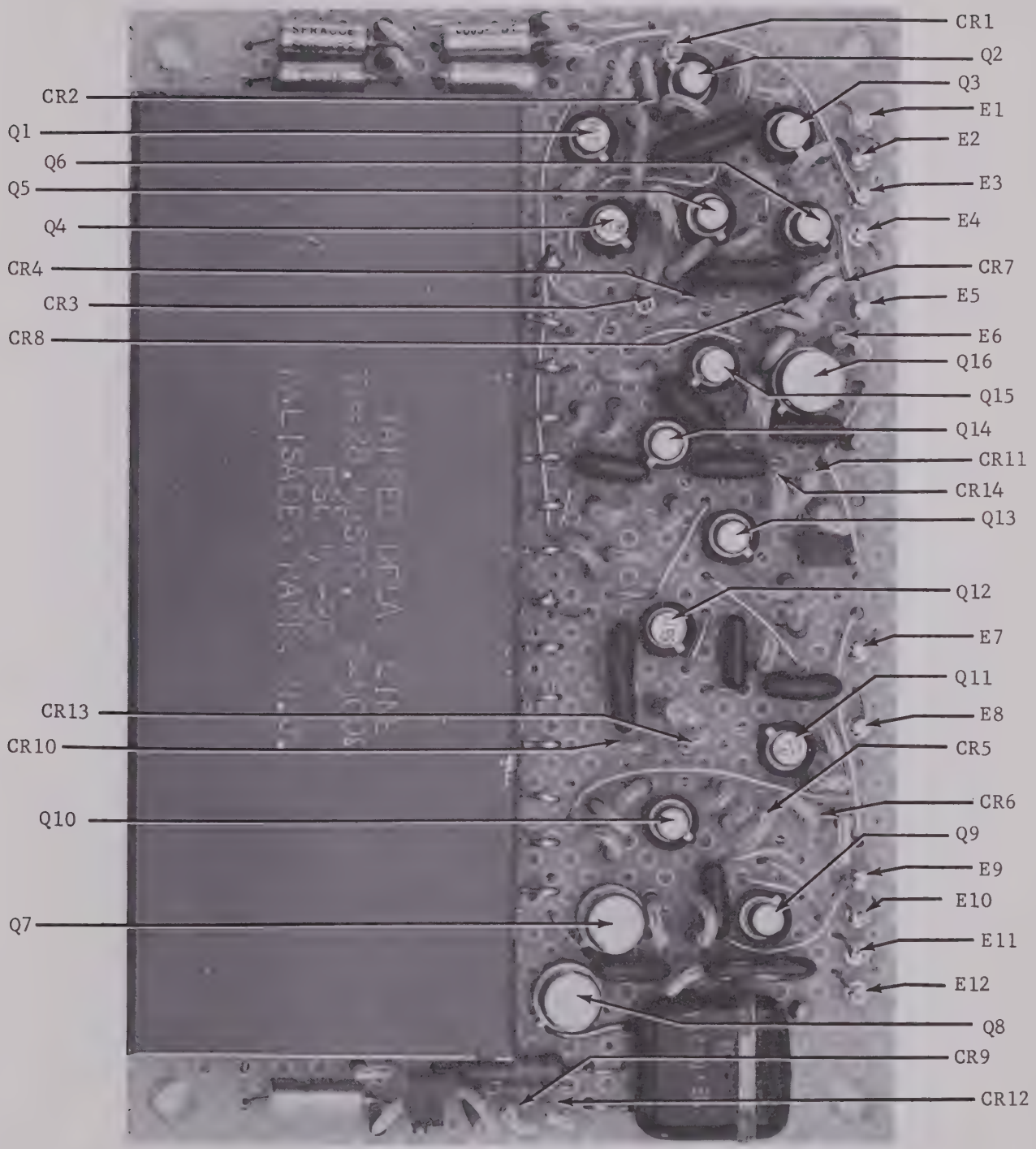


Figure 5-21. Control II Card 1A2A1A1A4 Showing Diode, Transistor, and Terminal Locations

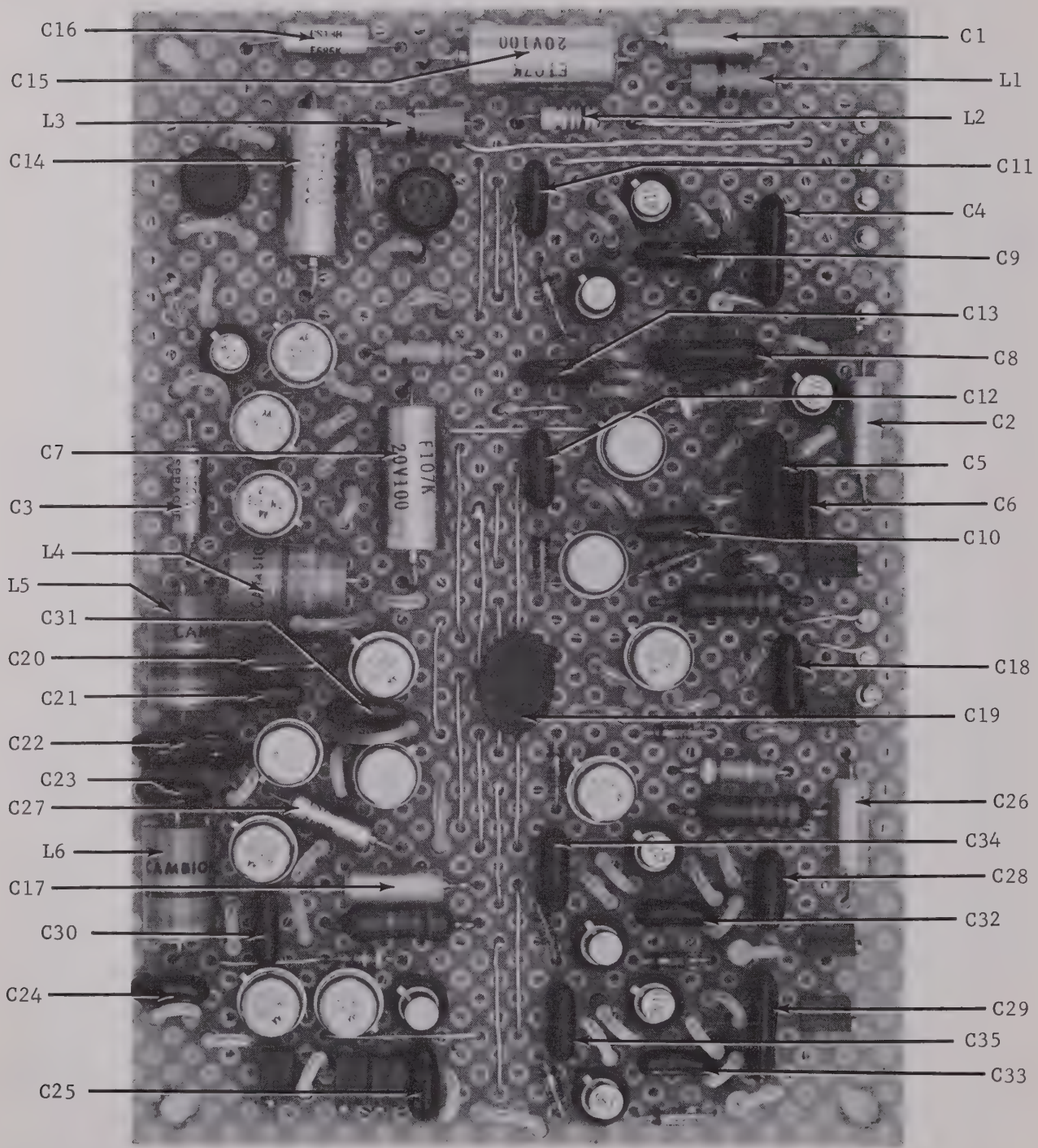


Figure 5-22. Encoder/Modulator Card 1A2A1A1A5 Showing Capacitor and Inductor Locations

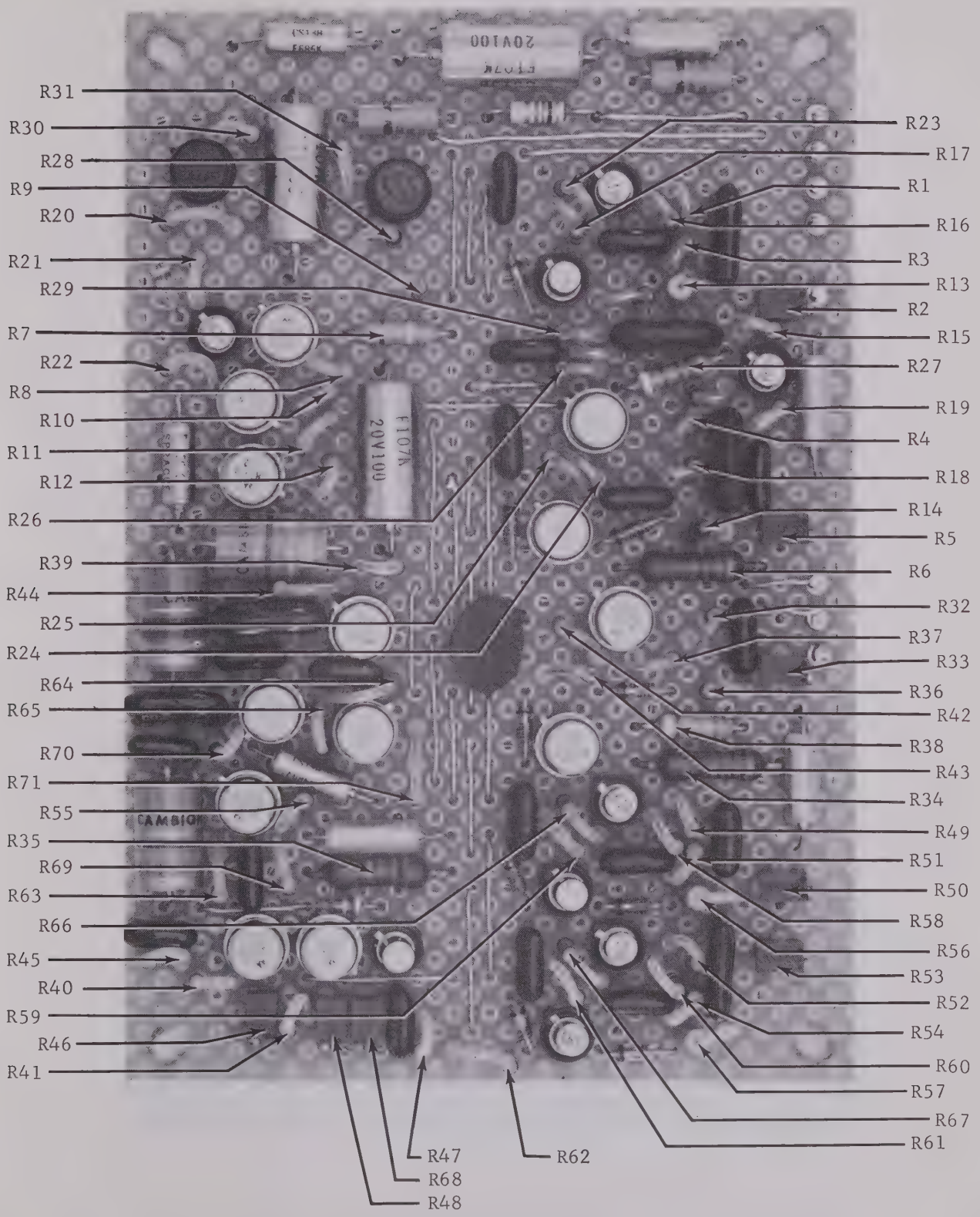


Figure 5-23. Encoder/Modulator Card 1A2A1A1A5 Showing Resistors

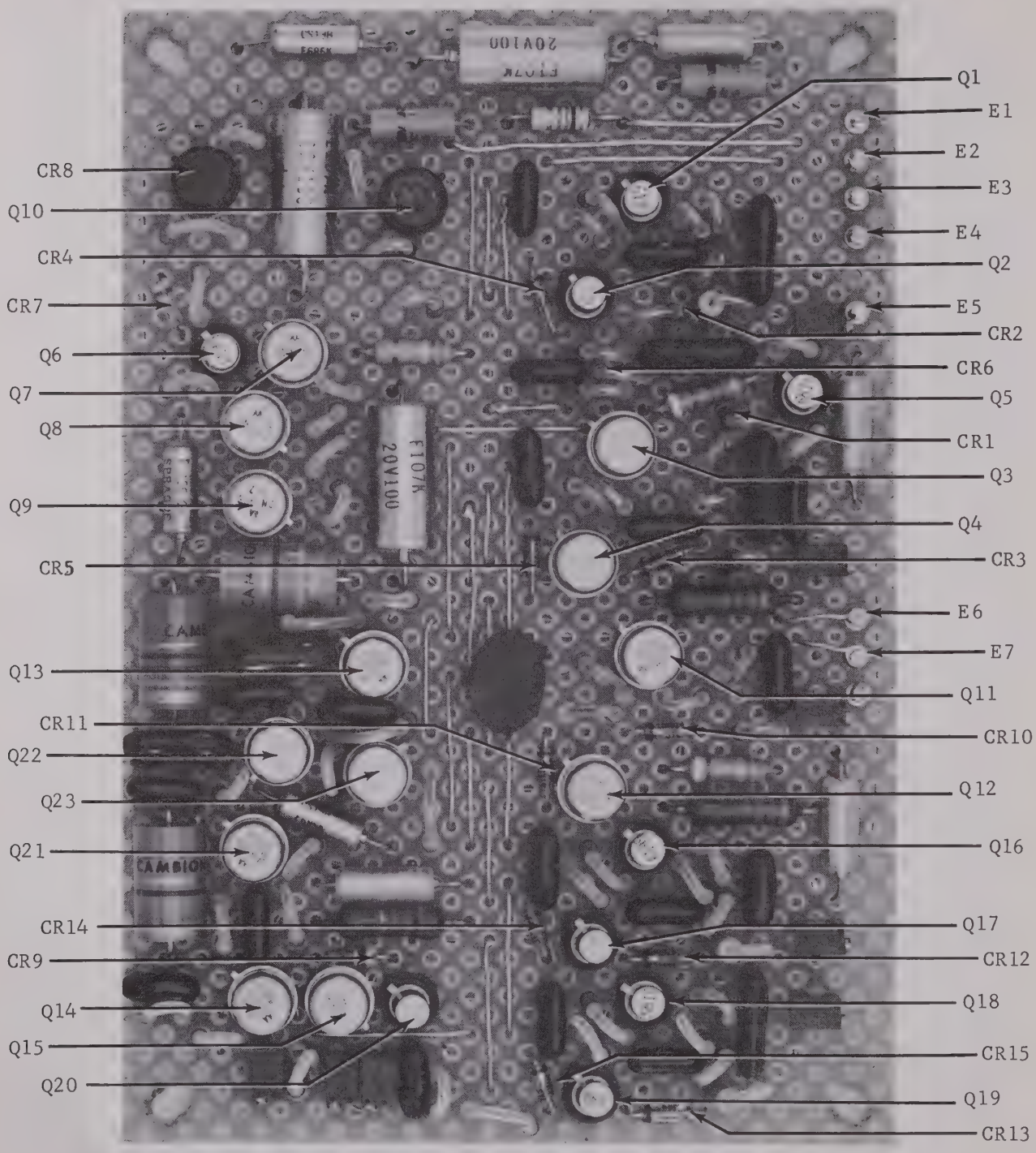


Figure 5-24. Encoder/Modulator Card 1A2A1A1A5 Showing Diode, Transistor, and Terminal Locations

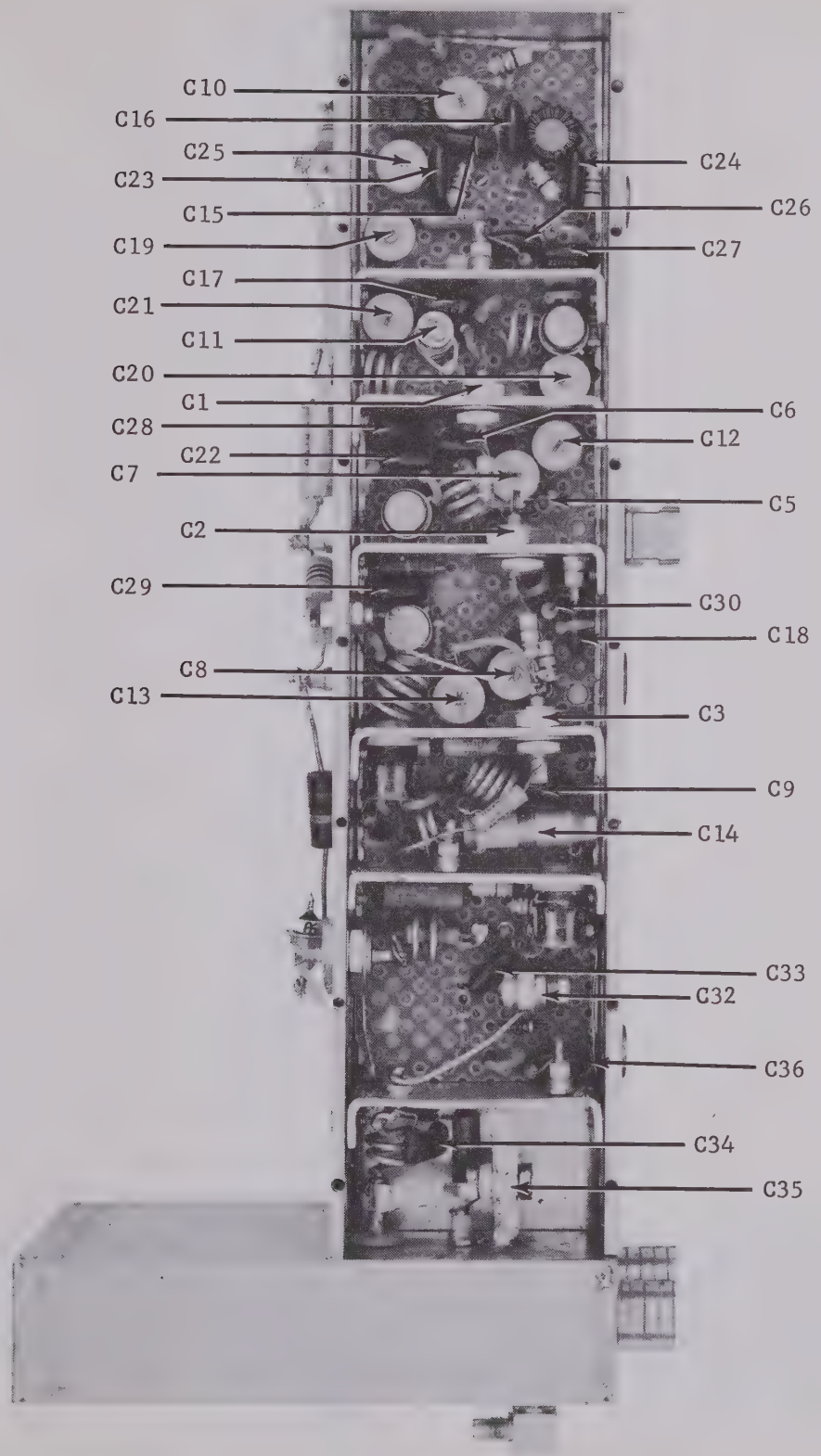


Figure 5-25. Frequency Multiplier Chain 1A2A1A3 (Transmitter Portion) Showing Capacitor Locations

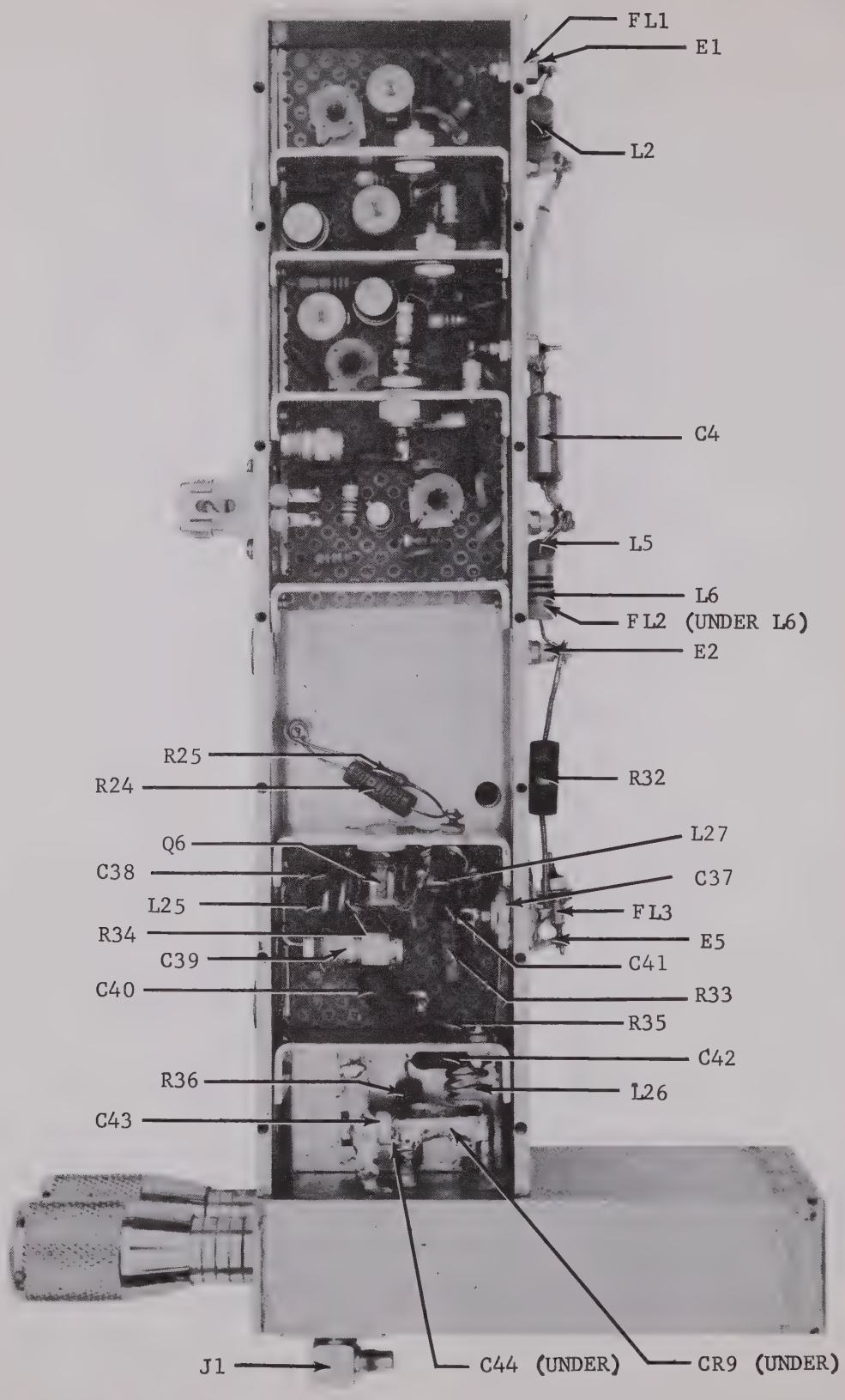


Figure 5-28. Frequency Multiplier Chain 1A2A1A3 (LO Portion) Showing Capacitor, Diode, Conductor, Resistor, Inductor, Filter, and Terminal Locations

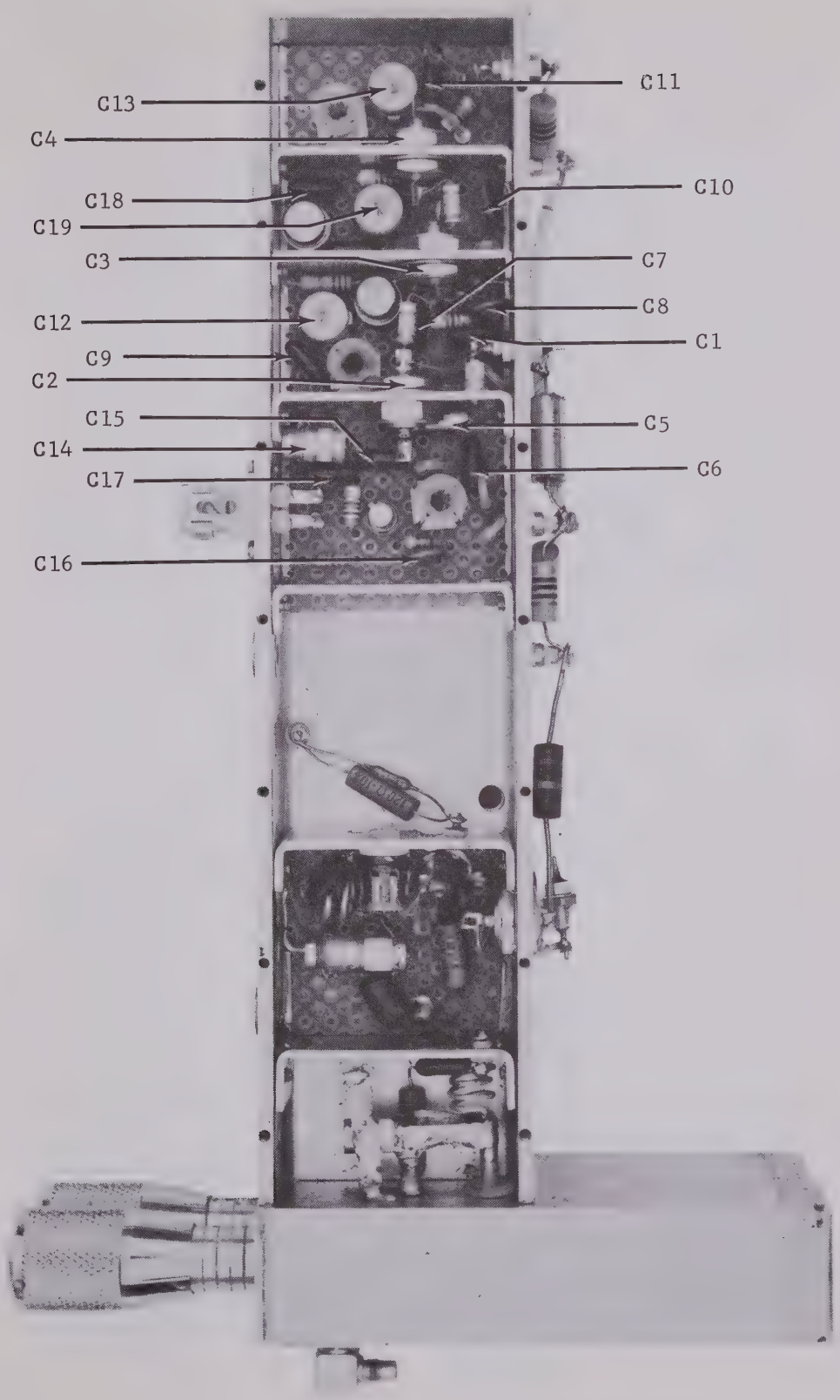


Figure 5-29. Frequency Multiplier Chain 1A2A1A3 (Crystal Controlled Oscillator Portion) Showing Capacitor Locations

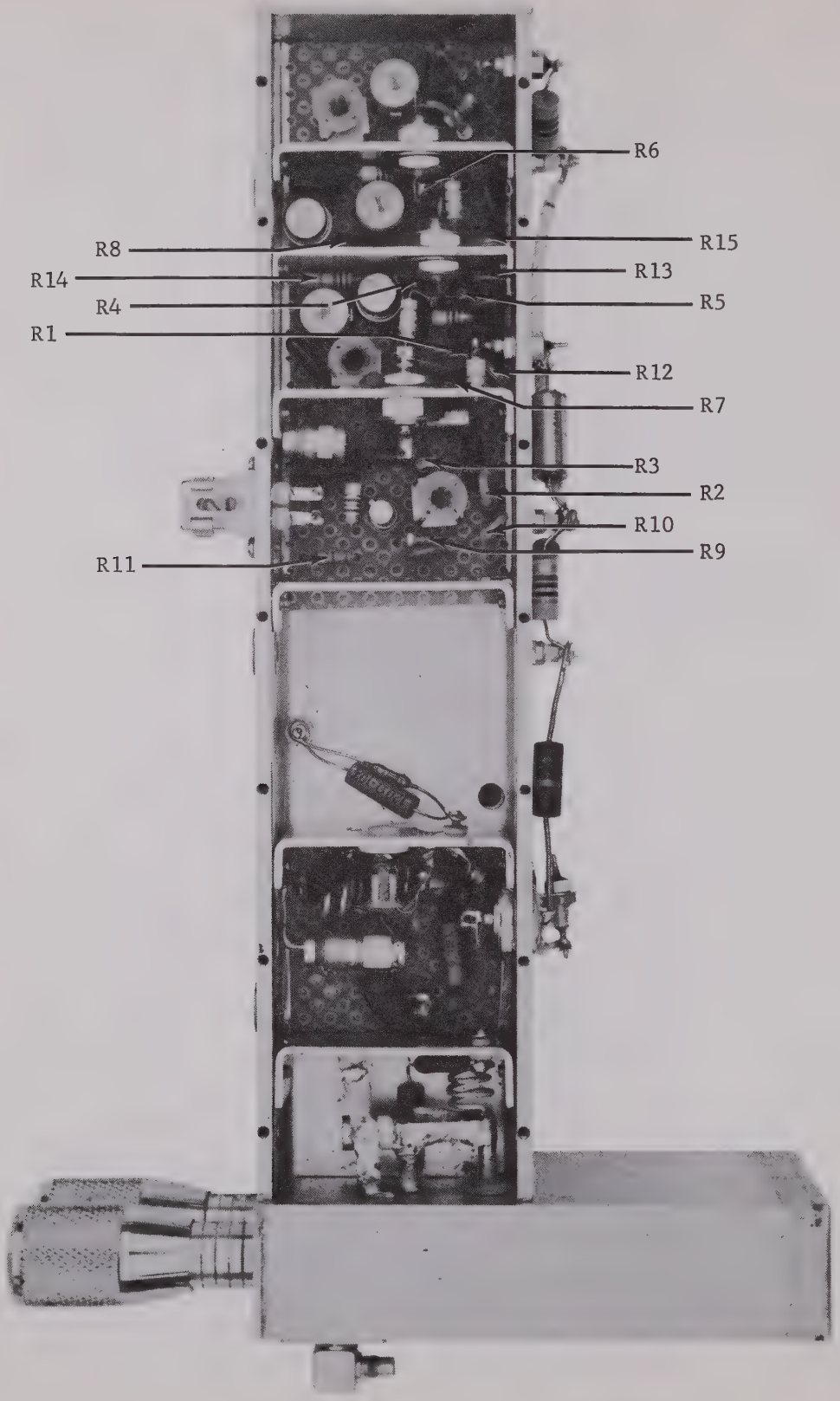


Figure 5-30. Frequency Multiplier Chain 1A2A1A3 (Crystal Controlled Oscillator Portion) Showing Resistor Locations

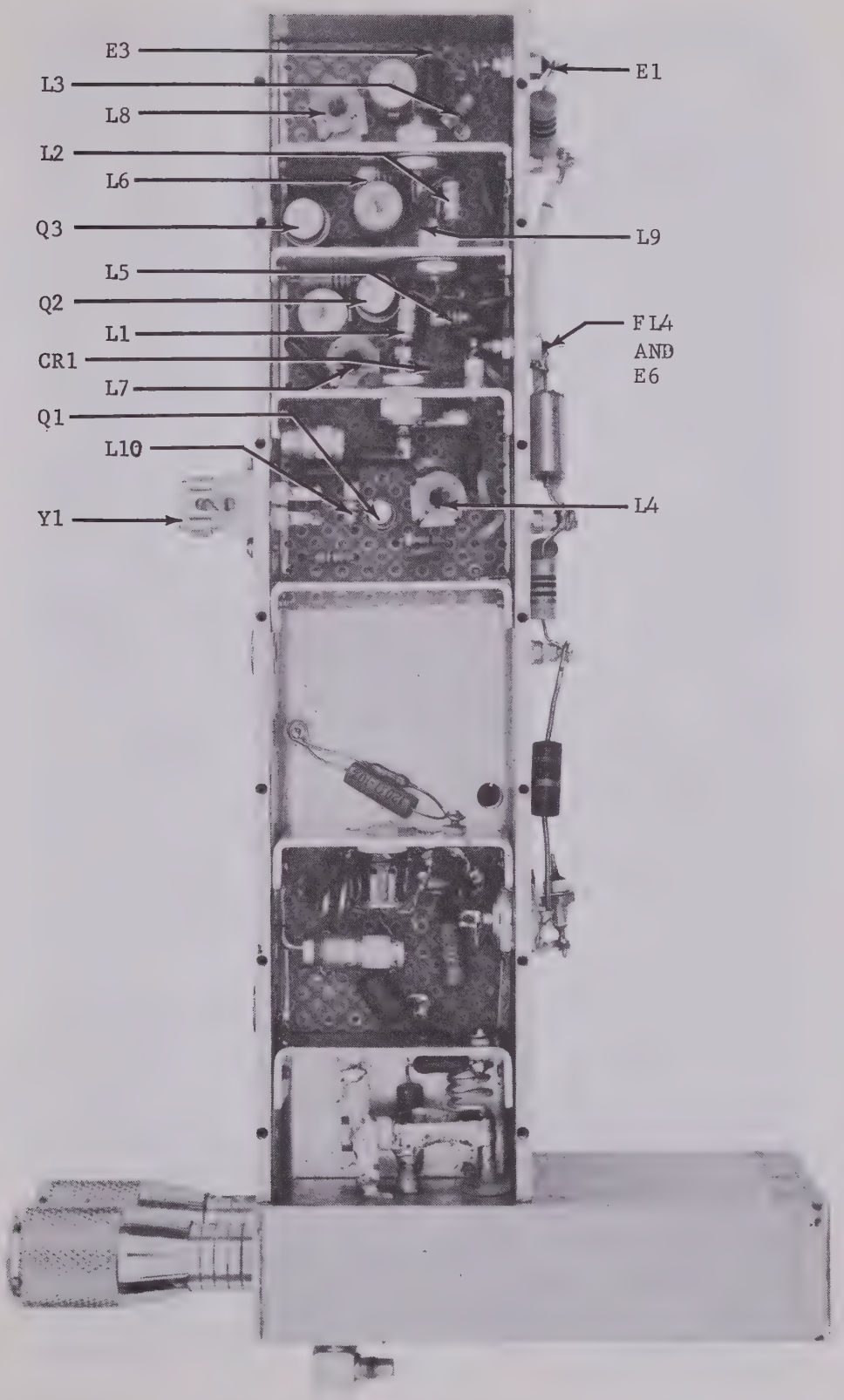
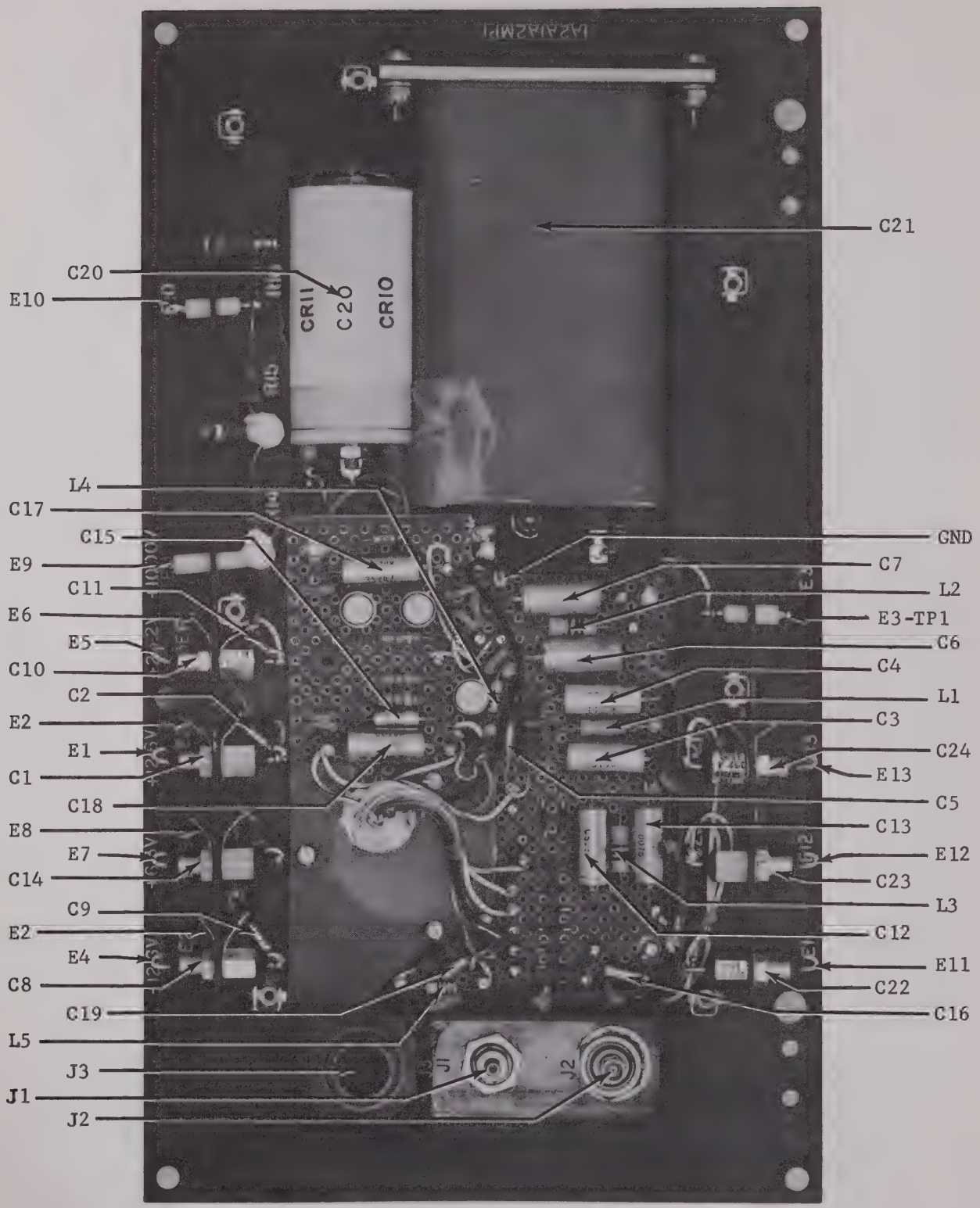


Figure 5-31. Frequency Multiplier Chain 1A2A1A3 (Crystal Controlled Oscillator Portion) Showing Diode, Transistor, Inductor, Terminal, Filter, and Crystal Locations



NOTE: Parts Hidden Under the Circuit Board Are Identified on Figure 5-33.

Figure 5-32. Transponder Power Supply (With Cover Removed and Circuit Board In Position) Showing Capacitor, Terminal, Inductor, Test Point, Ground, and Conductor Locations

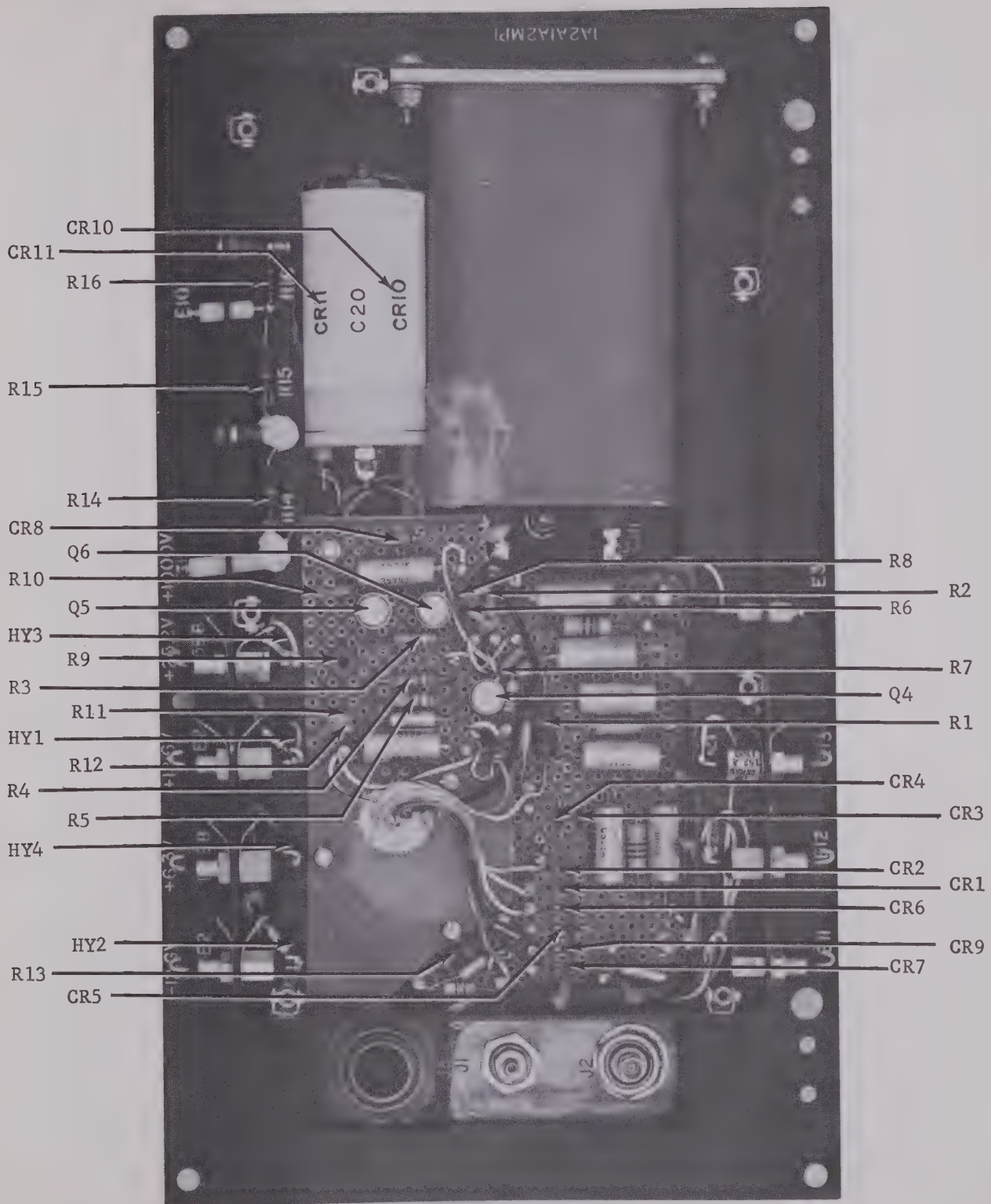


Figure 5-33. Transponder Power Supply (With Cover Removed and Circuit Board In Position) Showing Diode, Resistor, Transistor, and Wire Locations

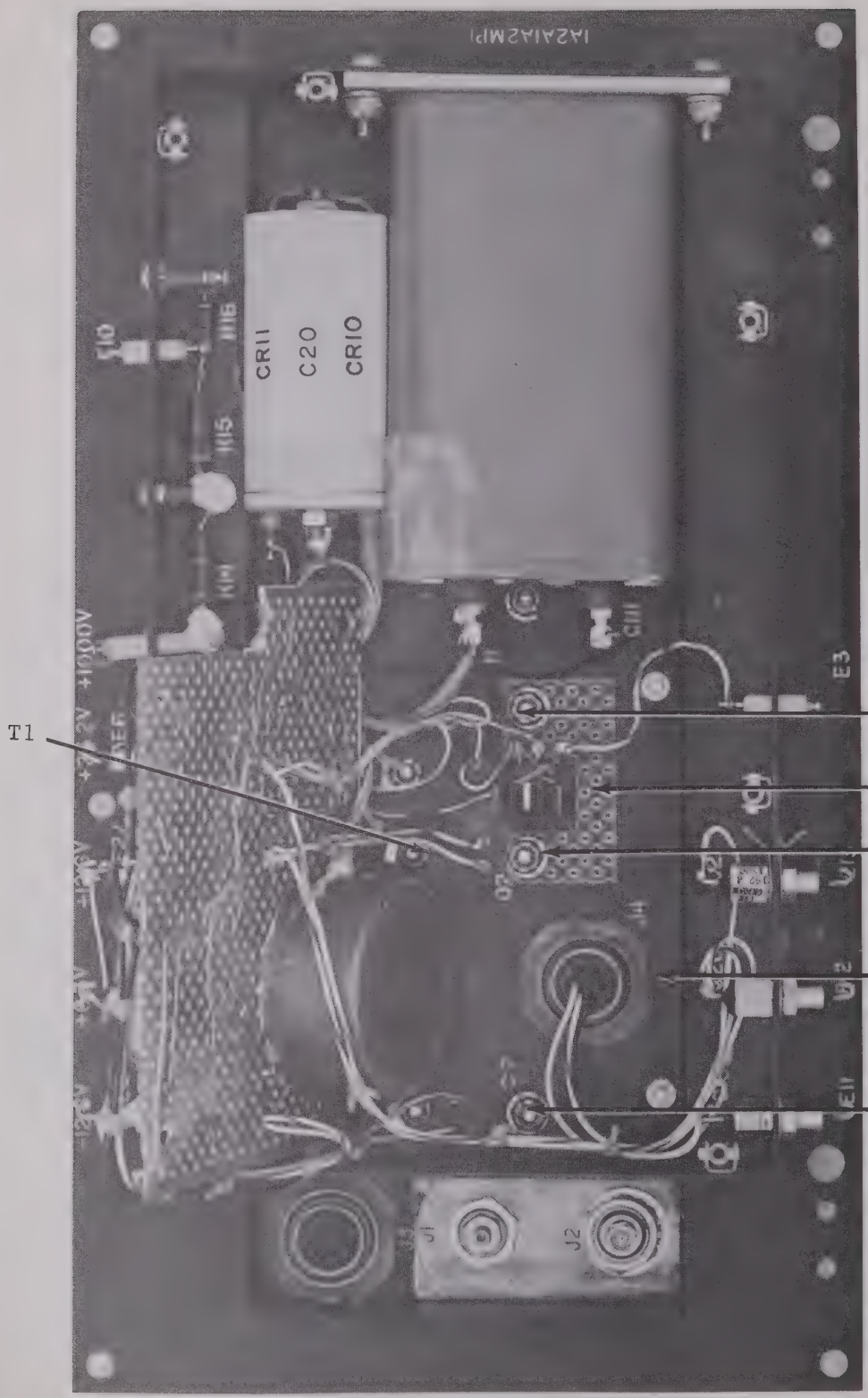


Figure 5-34. Transponder Power Supply (With Cover Removed and Circuit Board Raised) Showing Transformer, Transistor, and Connector Locations

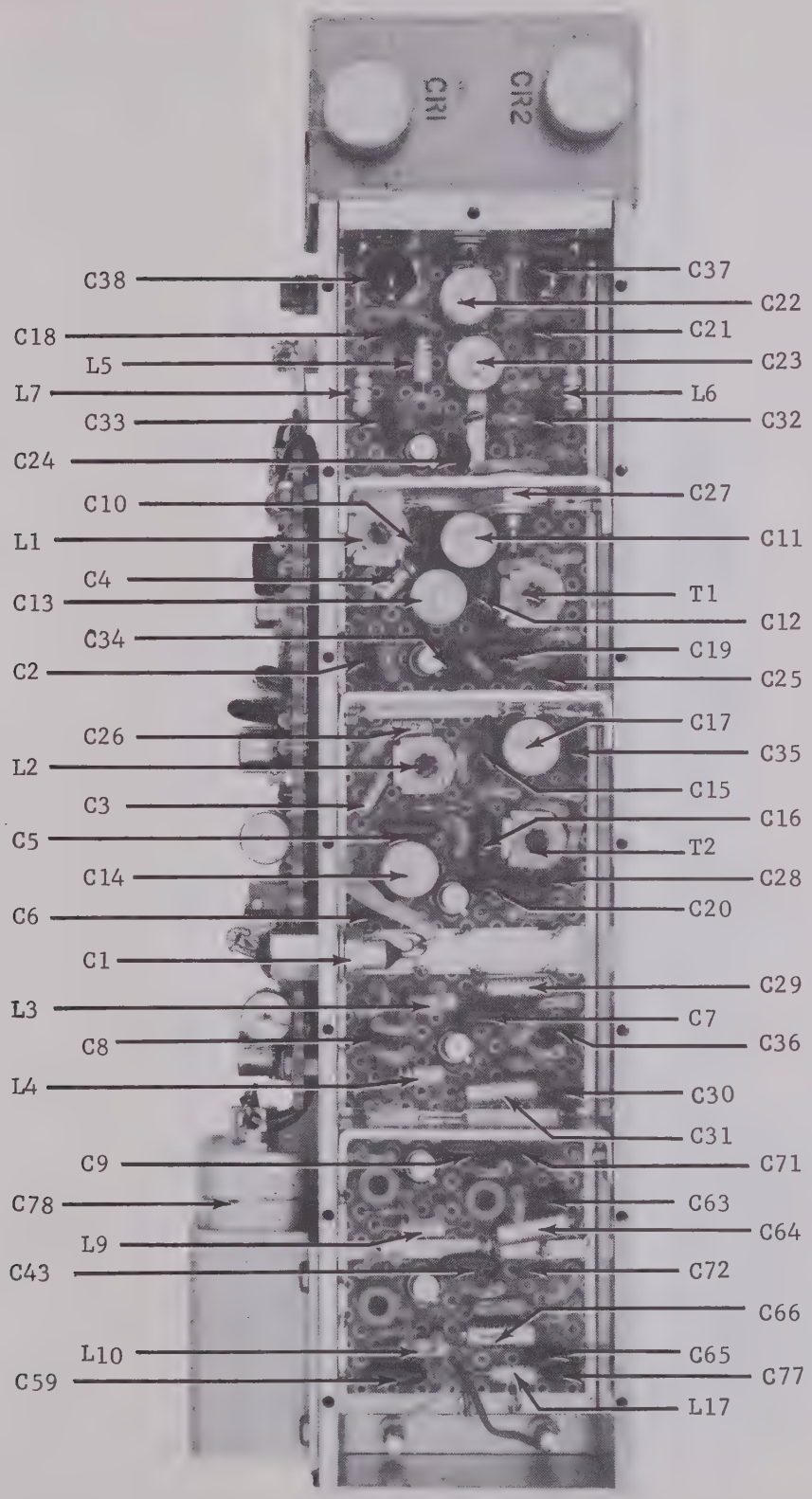


Figure 5-35. Receiver (I-F Stages 1 Thru 6) Showing Capacitor, Inductor, and Transformer Locations

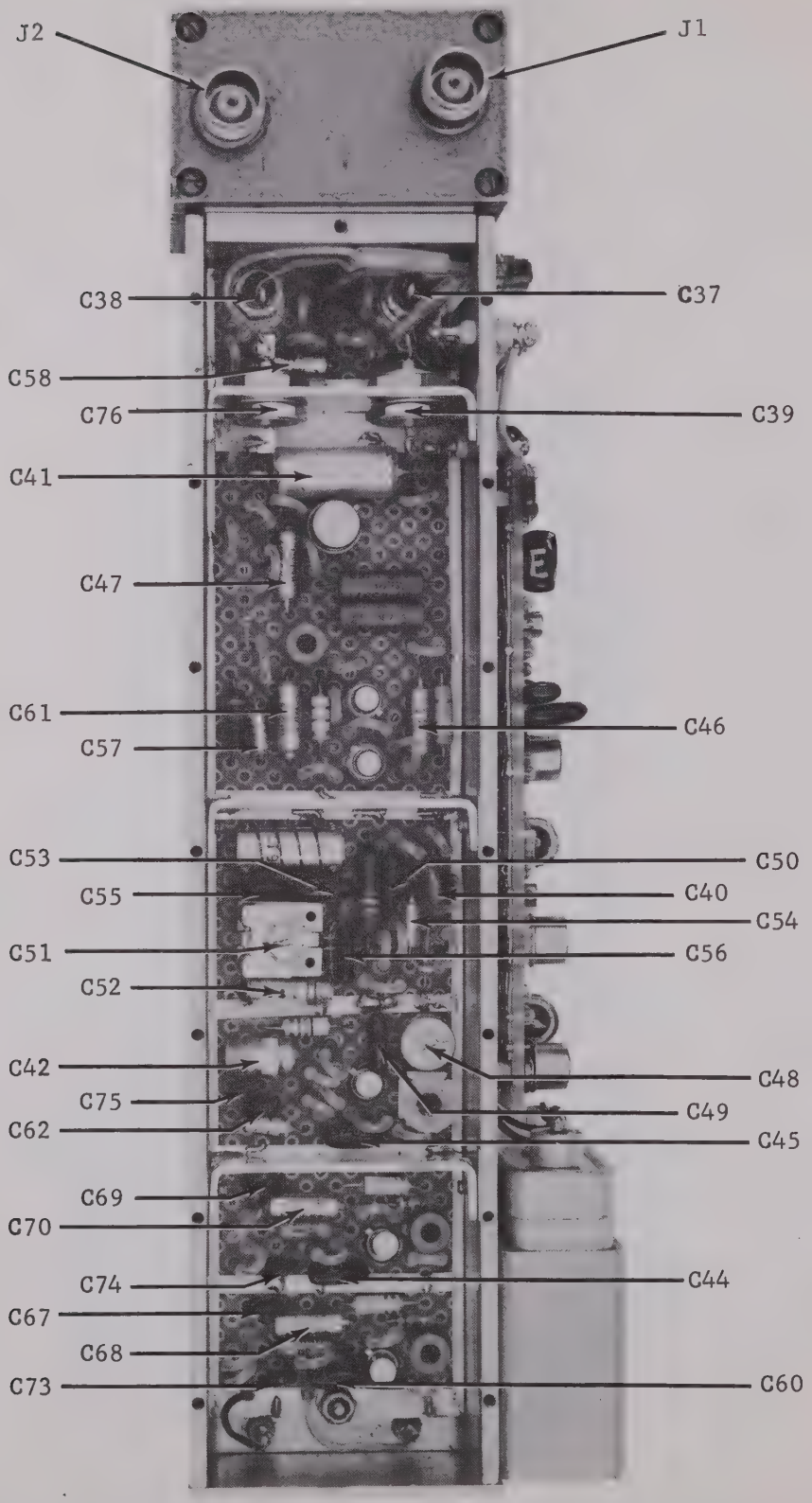


Figure 5-38. Receiver (Mixer, I-F Stages 7 and 8, Ferris Discriminator, and Video Amplifier) Showing Capacitor Locations

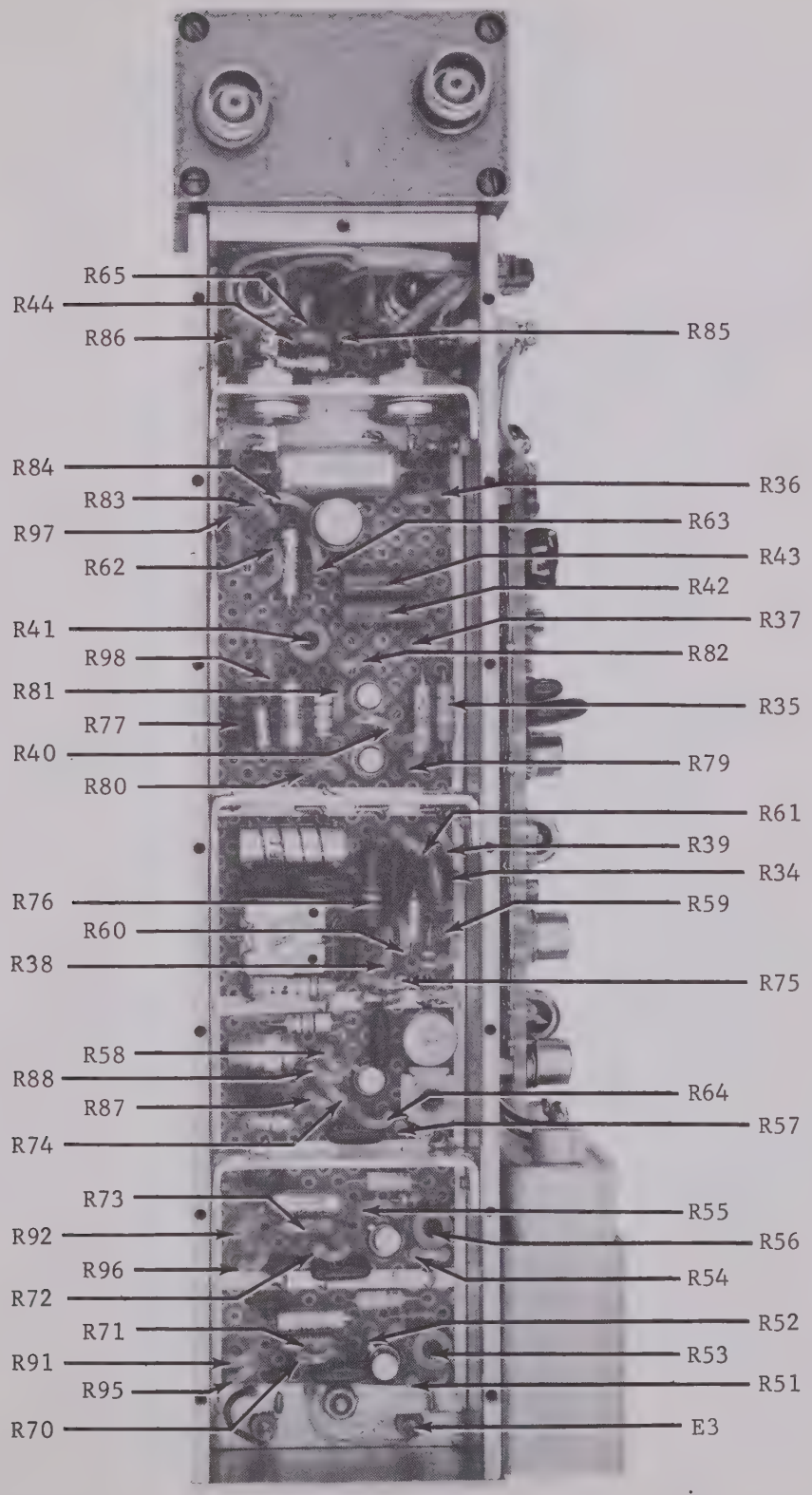


Figure 5-39. Receiver (Mixer, I-F Stages 7 and 8, Ferris Discriminator, and Video Amplifier) Showing Resistor Locations

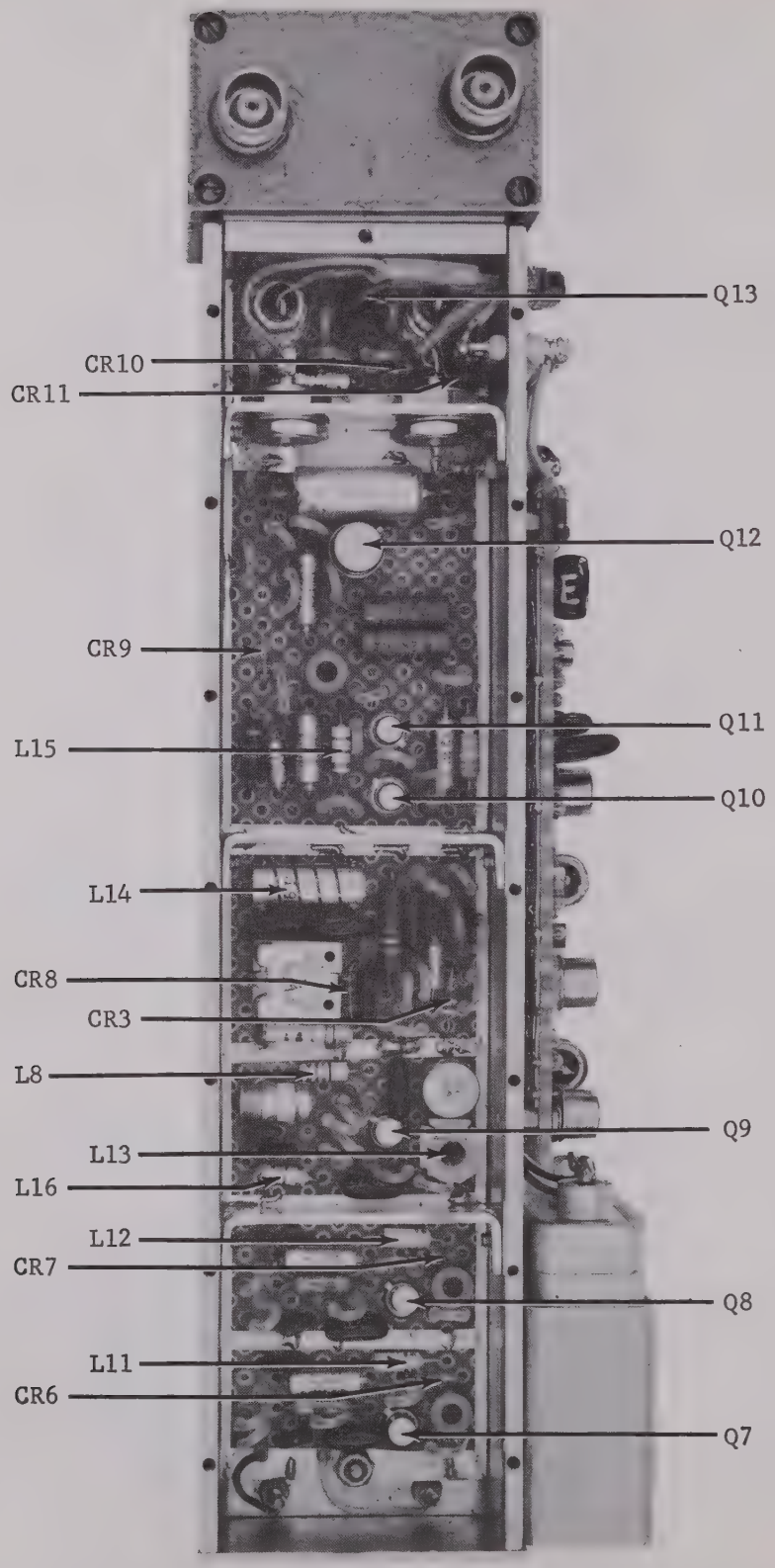


Figure 5-40. Receiver (Mixer, I-F Stages 7 and 8, Ferris Discriminator, and Video Amplifier) Showing Transistor, Diode, and Inductor Locations

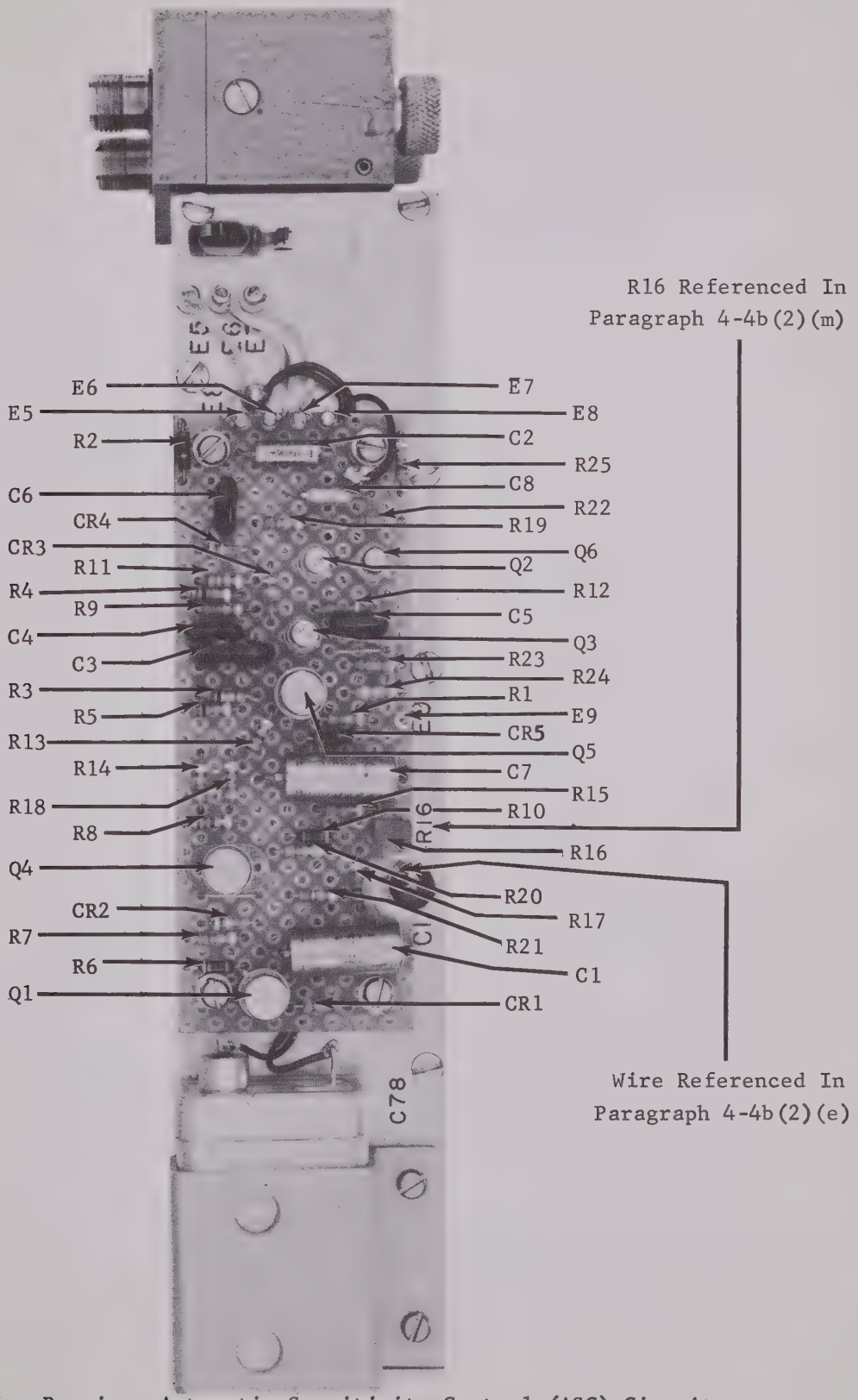


Figure 5-41. Receiver-Automatic Sensitivity Control (ASC) Circuit Showing Capacitor, Transistor, Terminal, and Diode Locations

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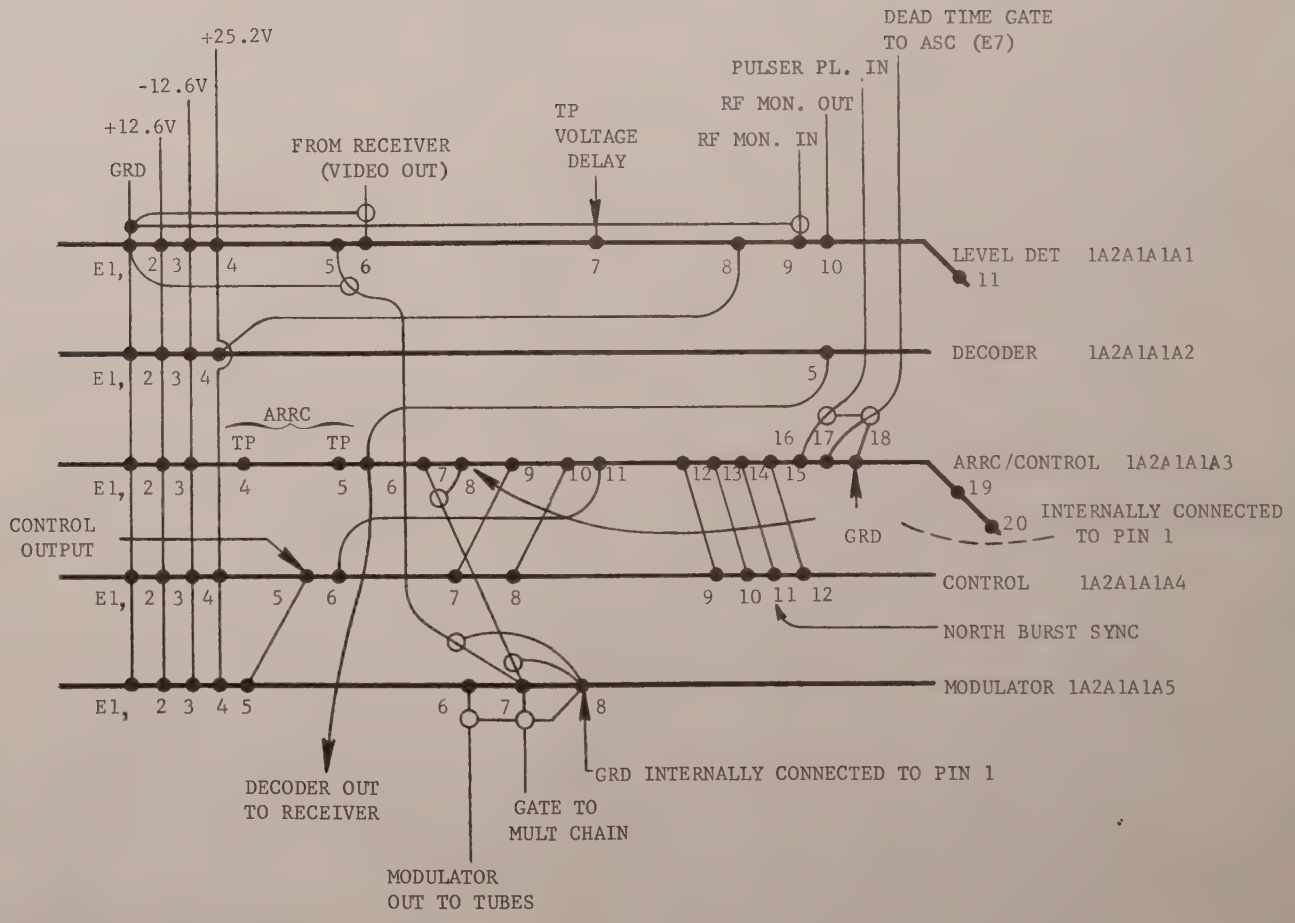

Figure 5-42. Circuit Boards Interwiring Diagram

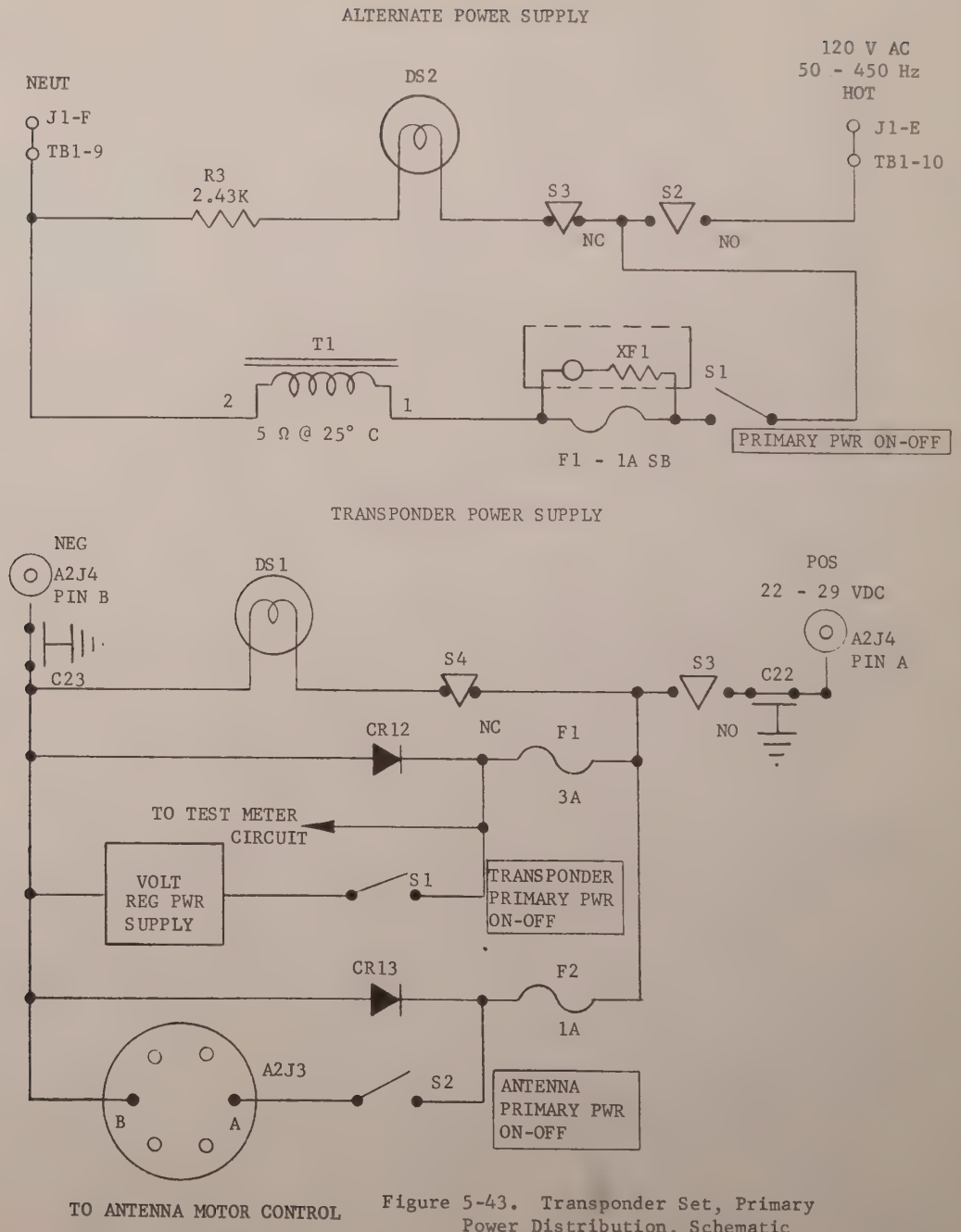

Figure 5-43. Transponder Set, Primary Power Distribution, Schematic Diagram

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PART LOCATION INDEX

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	A14	C53	F12	L11	F6	R32	D11
C2	A9	C54	F12	L12	F7	R33	D13
C3	A11	C55	F12	L13	F9	R34	E10
C4	A6	C56	F12	L14	F11	R35	E12
C5	A10	C57	F13	L15	G14	R36	E16
C6	A11	C58	F16	L16	H8	R37	E13
C7	A12	C59	F4	L17	H4	R38	F10
C8	A13	C60	F5	P1	J10	R39	F13
C9	A14	C61	G14	Q1	B5	R40	F14
C10	B6	C62	G9	Q2	B9	R41	F14
C11	B6	C63	G2	Q3	B12	R42	F15
C12	B6	C64	G3	Q4	B13	R43	F16
C13	B7	C65	G4	Q5	F2	R44	F16
C14	B9	C66	G4	Q6	F4	R45	F2
C15	B9	C67	G6	Q7	F5	R46	F2
C16	B10	C68	G6	Q8	F7	R47	F3
C17	B11	C69	G7	Q9	F9	R48	F3
C18	B3	C70	G8	Q10	F14	R49	F4
C19	B8	C71	H2	Q11	F15	R50	F4
C20	B11	C72	H4	Q12	G16	R51	F5
C21	B3	C73	H5	Q13	F17	R52	F5
C22	B4	C74	H7	R1	A9	R53	F6
C23	B4	C75	H9	R2	A11	R54	F7
C24	C6	C76	H16	R3	A13	R55	F7
C25	C9	C77	H3	R4	B6	R56	F8
C26	C10	C78	H12	R5	B7	R57	F8
C27	C5	CR1	A10	R6	B8	R58	F9
C28	C12	CR2	B14	R7	B10	R59	F10
C29	C12	CR3	F10	R8	B10	R60	F11
C30	C13	CR4	F3	R9	B10	R61	F13
C31	C14	CR5	F4	R10	B11	R62	F15
C32	C2	CR6	F6	R11	B12	R63	F16
C33	C3	CR7	F8	R12	B13	R64	G8
C34	C8	CR8	F12	R13	B13	R65	G17
C35	D12	CR9	G13	R14	B14	R66	G2
C36	D13	CR10	G16	R15	C5	R67	G2
C37	D3	CR11	G16	R16	C5	R68	G3
C38	D3	E1	B2	R17	C5	R69	G4
C39	E17	E2	C2	R18	C8	R70	G5
C40	E12	E3	G5	R19	C8	R71	G5
C41	E16	J1	B1	R20	C11	R72	G6
C42	E9	J2	C1	R21	C12	R73	G7
C43	F3	L1	B5	R22	C13	R74	G9
C44	F6	L2	B9	R23	C13	R75	G11
C45	F8	L3	B12	R24	C11	R76	G12
C46	F12	L4	B14	R25	C13	R77	G12
C47	F15	L5	B4	R26	C2	R78	G13
C48	F10	L6	C3	R27	C3	R79	G13
C49	F10	L7	C3	R28	C3	R80	G14
C50	F10	L8	F12	R29	C4	R81	G14
C51	F11	L9	F2	R30	C5	R82	G15
C52	F11	L10	F4	R31	C8	R83	G15

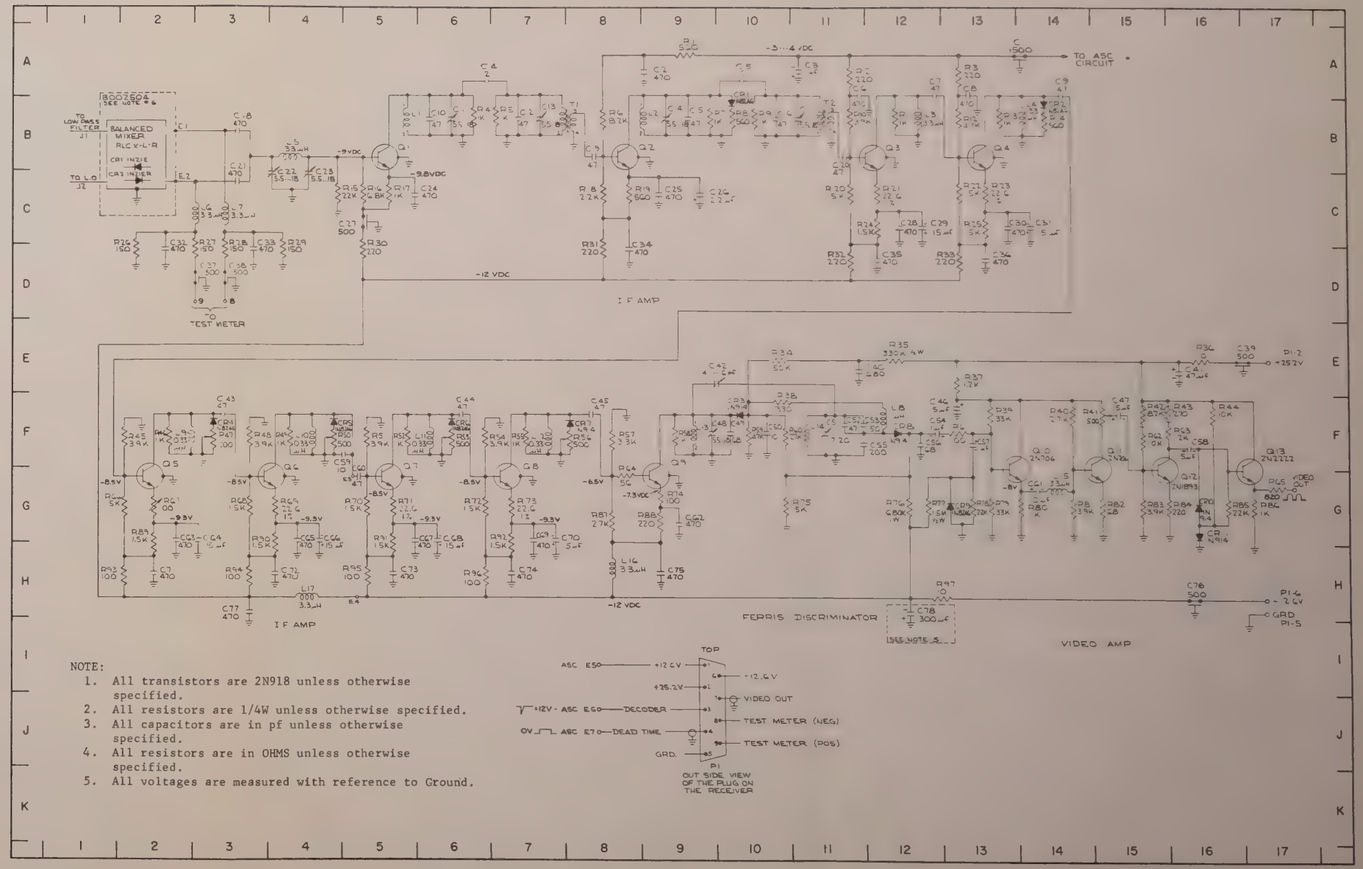


Figure 5-44. Receiver, Mixer, I-F Discriminator Video Amplifier (1A2A1A4), Schematic Diagram

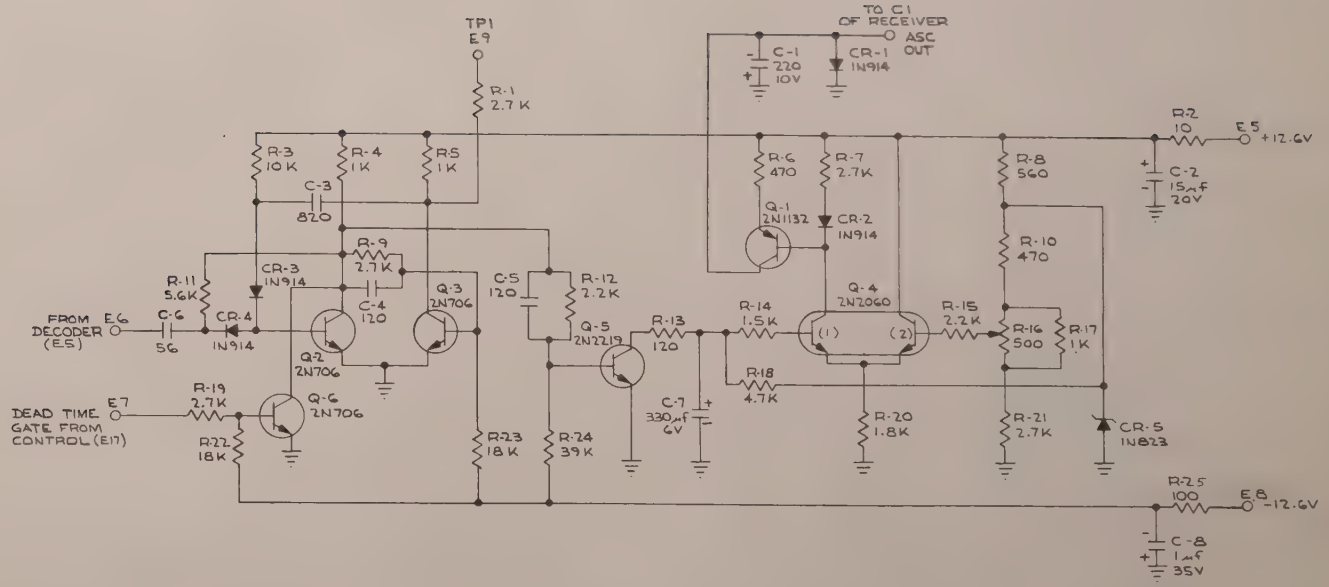
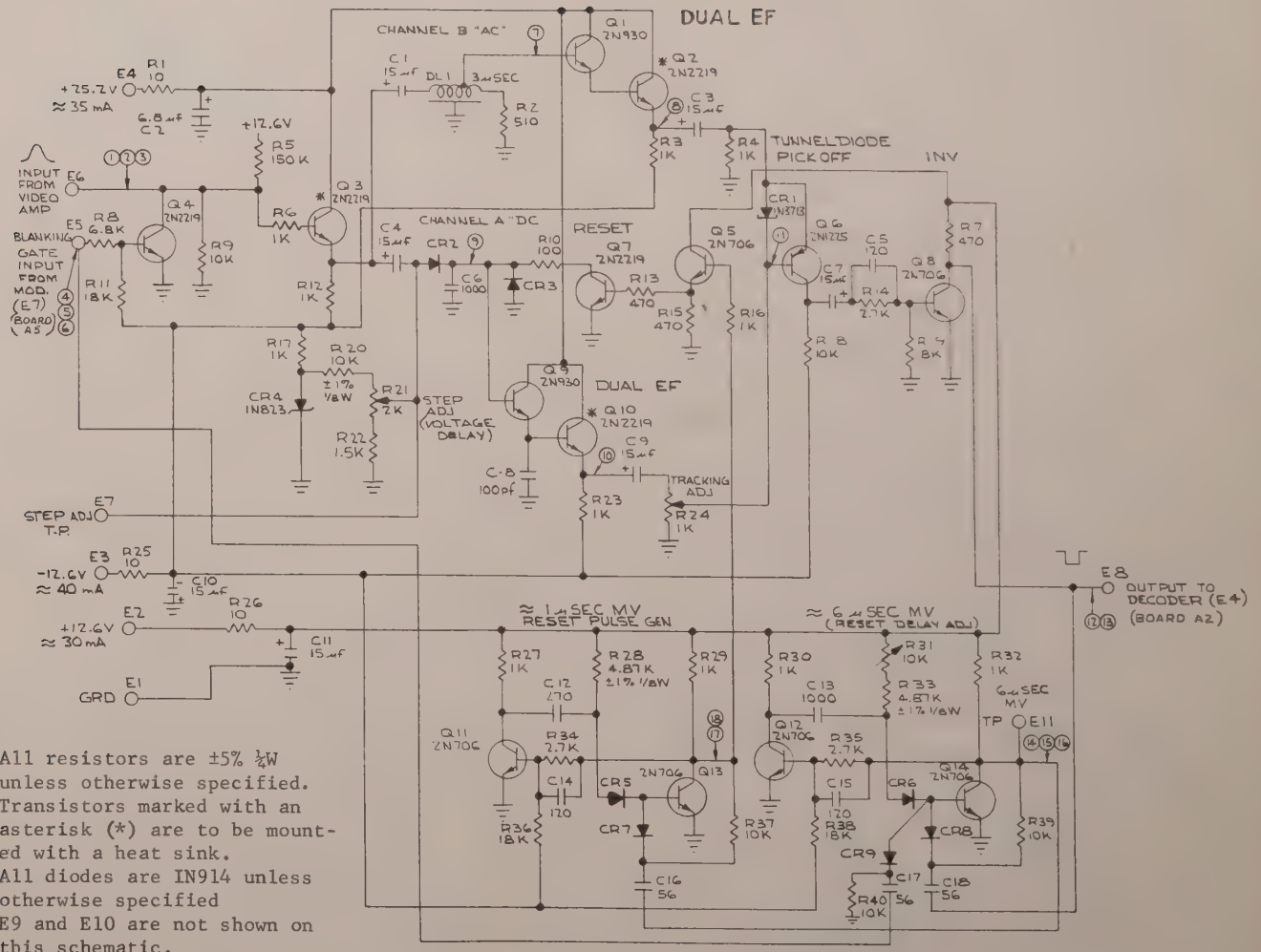


Figure 5-45. Automatic Sensitivity Control (ASC) (1A2A1A4A1), Schematic Diagram



NOTE:

1. All resistors are ±5% ¼W unless otherwise specified.
2. Transistors marked with an asterisk (*) are to be mounted with a heat sink.
3. All diodes are IN914 unless otherwise specified
4. E9 and E10 are not shown on this schematic.
5. Circled numbers refer to waveform pictures.

Figure 5-46. Level Detector, (Circuit Board, 1A2A1A1A1), Schematic Diagram

PART LOCATION INDEX

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	A11	CR12	I7	R1	A3	R31	D13
C2	B6	CR13	I7	R2	A4	R32	D17
C3	B7	CR14	I13	R3	A5	R33	D20
C4	B8	CR15	J13	R4	A8	R34	E3
C5	B13	CR16	J18	R5	A8	R35	G2
C6	B17	CR17	J19	R6	A9	R36	G5
C7	C3	DL1	I11	R7	A12	R37	G7
C8	C13	E1	E1	R8	A13	R38	G8
C9	D5	E2	G1	R9	A14	R39	G14
C10	D8	E3	E1	R10	A15	R40	G15
C11	D15	E4	I1	R11	A16	R41	G19
C12	D18	E5	B21	R12	A17	R42	G20
C13	F4	Q1	C4	R13	A19	R43	I6
C14	G4	Q2	C6	R14	A20	R44	H9
C15	H6	Q3	C8	R15	A21	R45	H12
C16	H6	Q4	C9	R16	B6	R46	H13
C17	I8	Q5	C11	R17	B7	R47	H15
C18	J15	Q6	C13	R18	B20	R48	H16
C19	J20	Q7	C15	R19	C3	R49	H20
CR1	C10	Q8	C16	R20	C9	R50	I17
CR2	B19	Q9	C19	R21	C11	R51	I6
CR3	B20	Q10	C21	R22	C13	R52	I7
CR4	C14	Q11	H6	R23	C17	R53	J10
CR5	C18	Q12	H8	R24	D6	R54	J12
CR6	C10	Q13	H10	R25	D7	R55	J14
CR7	C14	Q14	H14	R26	D15	R56	J17
CR8	C18	Q15	H16	R27	C19	R57	J19
CR9	D5	Q16	H17	R28	E6		
CR10	D8	Q17	H19	R29	E7		
CR11	D19	Q18	H20	R30	E11		

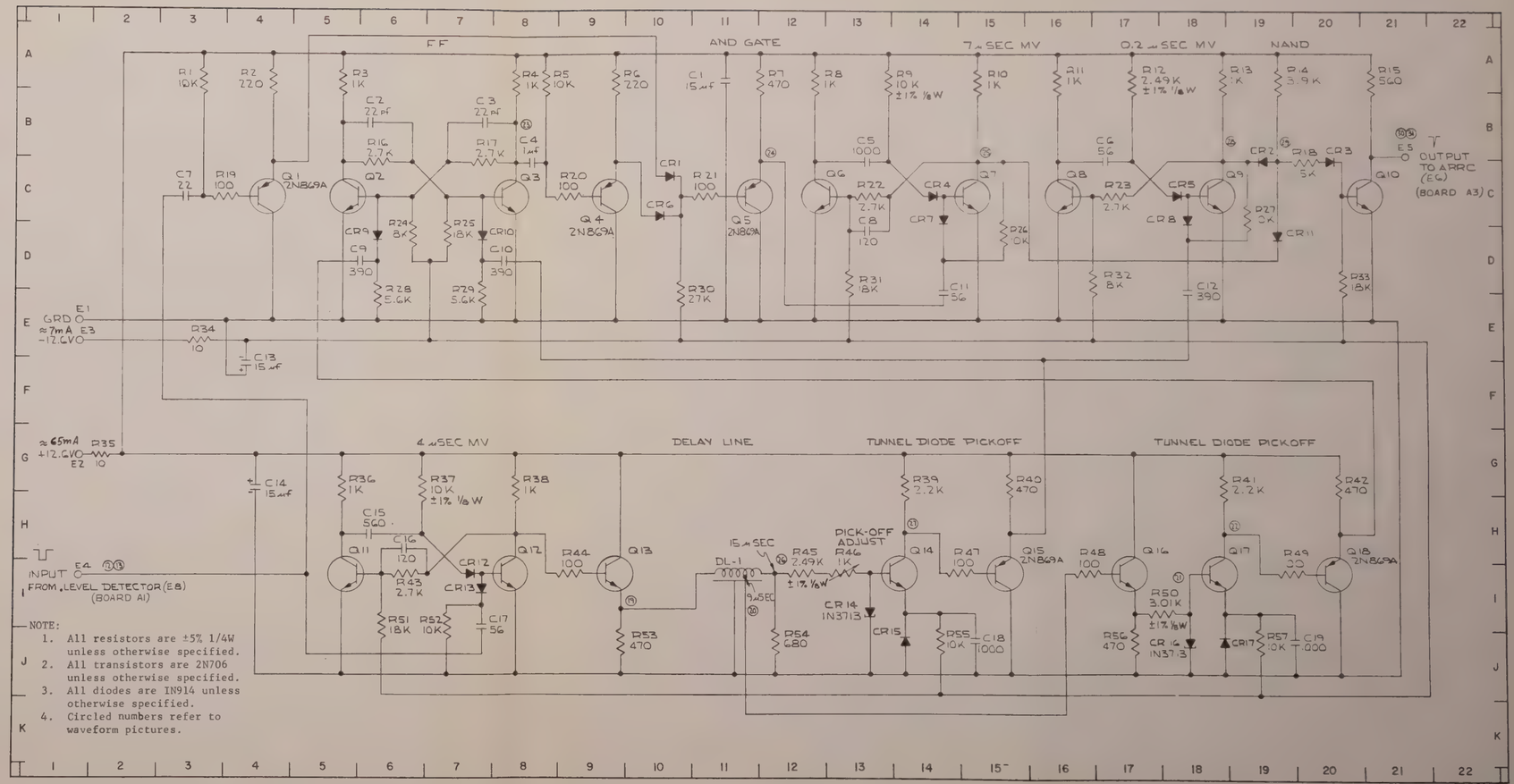


Figure 5-47. Decoder Logic, (Circuit Board 1A2A1A1A2), Schematic Diagram

PART LOCATION INDEX

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	B8	CR6	G13	R2	A13	R31	E8
C2	B7	CR7	G4	R3	B3	R32	E16
C3	B10	CR8	G13	R4	B4	R33	F4
C4	B12	CR9	G4	R5	B6	R34	F6
C5	B16	CR10	H4	R6	B6	R35	F7
C6	C2	CR11	I15	R7	B7	R36	F11
C7	B3	CR12	J6	R8	B8	R37	F13
C8	B8	E1	E17	R9	B9	R38	F15
C9	C5	E2	F17	R10	B10	R39	G6
C10	C6	E3	D17	R11	B11	R40	G8
C11	D7	E4	A12	R12	B11	R41	G4
C12	D10	E5	E8	R13	B12	R42	G14
C13	D12	E6	H2	R14	B14	R43	H3
C14	D14	E7	J5	R15	B16	R44	H9
C15	D6	E8	J6	R16	B15	R45	H11
C16	D14	Q1	B4	R17	C13	R46	H13
C17	F8	Q2	B7	R18	C5	R47	H14
C18	F5	Q3	B10	R19	D4	R48	H17
C19	G6	Q4	B11	R20	D4	R49	I14
C20	G15	Q5	B14	R21	D6	R50	I5
C21	G2	Q6	B15	R22	D7	R51	I6
C22	H2	Q7	G5	R23	D9	R52	I8
C23	I9	Q8	G7	R24	D10	R53	I8
C24	I13	Q9	G11	R25	D11	R54	I10
CR1	D3	Q10	H11	R26	D11	R55	I12
CR2	D5	Q11	H18	R27	D13	R56	I14
CR3	D8	Q12	H5	R28	D15	R57	I18
CR4	D13	Q13	H9	R29	D17	R58	J5
CR5	D14	R1	A6	R30	D16		

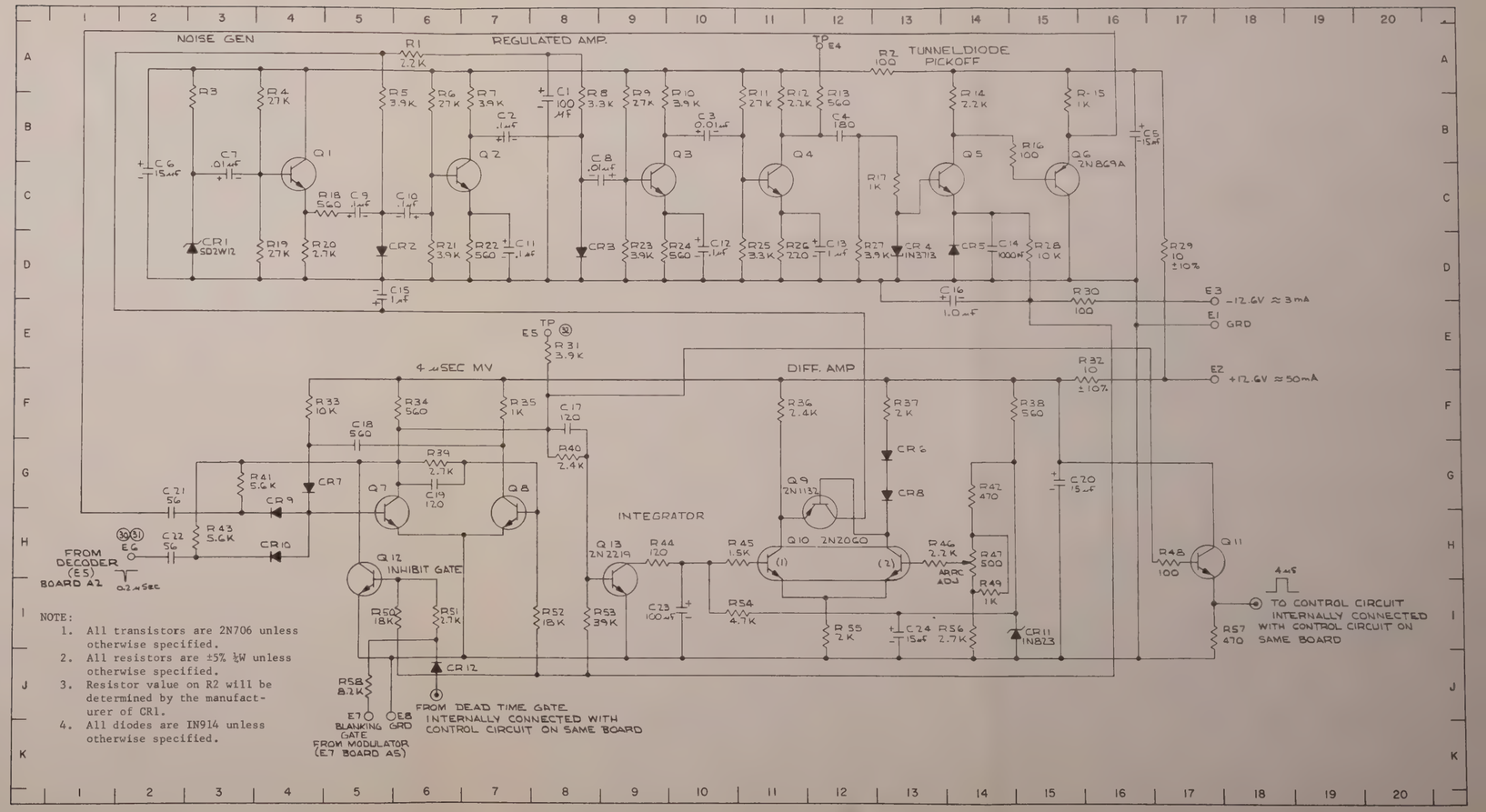


Figure 5-48. ARRC Circuit (Circuit Card, 1A2A1A4), Schematic Diagram

PART LOCATION INDEX

CIRCUIT CARD 1A2A1A3
(Outside Dotted Line)

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C25	B4	CR21	I5	Q15	B3	R70	B9
C26	B2	CR22	I9	Q16	B3	R71	C1
C27	B4	CR23	I10	Q17	B4	R72	C4
C28	B6	CR24	J5	Q18	B6	R73	B6
C29	B4	CR25	I8	Q19	B7	R74	C7
C30	B7	CR26	I8	Q20	B9	R75	C9
C31	B2	DS1	C1	Q21	B10	R76	C4
C32	C5	E1	H10,D2,D10	Q22	B10	R77	C7
C33	C9	E2	A1	Q23	I6	R78	C8
C34	I7	E9	H15	Q24	I7	R79	C10
C35	I7	E10	H15,A10	Q25	I8	R80	C10
C36	I7	E11	C10	R59	A2	R81	D10
C37	J8	E12	H8	R60	B2	R82	I7
C38	J10	E13	E8	R61	B2	R83	I8
CR13	B9	E15	E4	R62	B2	R84	I9
CR14	B5	E16	C1	R63	B3	R85	I8
CR15	B8	E17	I4	R64	B4	R86	J7
CR16	C5	E18	D2	R65	B5	R87	J9
CR17	C8	E19	I7	R66	B6	R88	J10
CR18	C9	E20	I7	R67	B7	R89	J5
CR19	C9	Q1	C2	R68	B8	R90	J6
CR20	C3	Q14	B2	R69	B9	R91	J7

PART LOCATION INDEX

CIRCUIT CARD 1A2A1A4
(Inside Dotted Line)

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	B14	CR11	F11	Q13	F11	R25	F6
C2	C13	CR12	G4	Q14	F12	R26	F7
C3	D14	CR13	G8	Q15	F13	R27	F8
C4	D14	CR14	G11	Q16	F14	R28	F9
C5	D15	DL1	B10	R1	A14	R29	F10
C6	E3	E1	H10,E3,D10	R2	B11	R30	F11
C7	F2	E3	E2,A15	R3	B13	R31	F12
C8	F3	E4	E2	R4	B14	R32	F11
C9	F6	E5	B15	R5	B14	R33	F13
C10	F10	E6	C10	R6	B12	R34	F14
C11	F12	E7	H15	R7	B13	R35	G4
C12	F4	E8	H15,A10	R8	C11	R36	F6
C13	F9	E9	E6	R9	C12	R37	F7
C14	F12	E10	E7	R10	C13	R38	F9
C15	F14	E11	H8	R11	C14	R39	G10
C16	G11	E12	E4	R12	C13	R40	G12
C17	G5	Q1	B12	R13	C14	R41	F13
C18	G8	Q2	B12	R14	C11	R42	G14
CR1	C12	Q3	B13	R15	D12	R43	G8
CR2	C13	Q4	C12	R16	D13	R44	G4
CR3	D12	Q5	D12	R17	D11	R45	G4
CR4	D13	Q6	D14	R18	D13	R46	G6
CR5	F6	Q7	F3	R19	E2	R47	G7
CR6	F7	Q8	F5	R20	E2	R48	G10
CR7	F13	Q9	F6	R21	F3	R49	G12
CR8	F14	Q10	G7	R22	E4	R50	G13
CR9	F4	Q11	F8	R23	F4	R51	G14
CR10	F8	Q12	F10	R24	F5	R52	G14

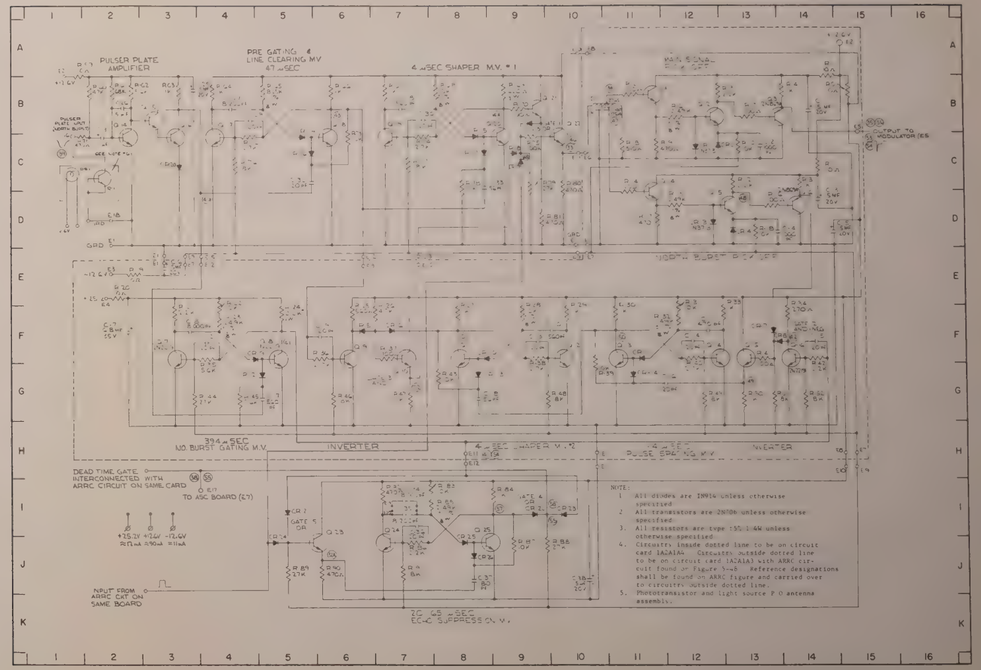


Figure 5-49. Control Section (Circuit Boards, 1A2A1A1A3 and 1A2A1A1A4), Schematic Diagram

PART LOCATION INDEX

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	A3	CR6	C11	Q17	I6	R34	E6
C2	A10	CR7	C13	Q18	I7	R35	E13
C3	B15	CR8	D15	Q19	I9	R36	E5
C4	B4	CR9	F13	Q20	I10	R37	F4
C5	B8	CR10	F5	Q21	J12	R38	F5
C6	B10	CR11	F5	Q22	I13	R39	F7
C7	B12	CR12	I5	Q23	I14	R40	F10
C8	B11	CR13	I9	R1	A4	R41	F11
C9	C4	CR14	J5	R2	A5	R42	F4
C10	C8	CR15	J8	R3	A6	R43	G5
C11	C5	E1	C2	R4	A7	R44	G6
C12	C9	E2	A2	R5	A8	R45	G10
C13	C10	E3	D2	R6	A9	R46	G11
C14	D13	E4	E2	R7	A13	R47	G12
C15	D15	E5	D2	R8	A14	R48	G12
C16	E2	E6	B16	R9	A14	R49	I4
C17	E13	E7	J15	R10	A14	R50	I5
C18	E4	E8	J15	R11	A15	R51	I6
C19	G5	L1	A2	R12	A15	R52	I7
C20	G7	L2	D2	R13	B5	R53	I8
C21	G7	L3	E2	R14	B8	R54	I9
C22	G8	L4	F8	R15	B11	R55	I12
C23	G9	L5	F8	R16	B4	R56	I5
C24	G9	L6	F9	R17	B6	R57	I8
C25	G11	Q1	B4	R18	B8	R58	I4
C26	I6	Q2	B5	R19	B10	R59	J6
C27	I14	Q3	B7	R20	C13	R60	I8
C28	I4	Q4	B9	R21	C13	R61	J10
C29	I8	Q5	B11	R22	C14	R62	I10
C30	I11	Q6	B13	R23	C4	R63	I11
C31	I13	Q7	B13	R24	C8	R64	I13
C32	J4	Q8	B14	R25	C8	R65	J14
C33	J8	Q9	B15	R26	C11	R66	J4
C34	J5	Q10	C14	R27	C12	R67	J8
C35	J9	Q11	F4	R28	C13	R68	J11
CR1	B10	Q12	F5	R29	D10	R69	J11
CR2	B5	Q13	F7	R30	D14	R70	J13
CR3	B9	Q14	F11	R31	D14	R71	J14
CR4	C5	Q15	F12	R32	E4		
CR5	C9	Q16	I4	R33	E5		

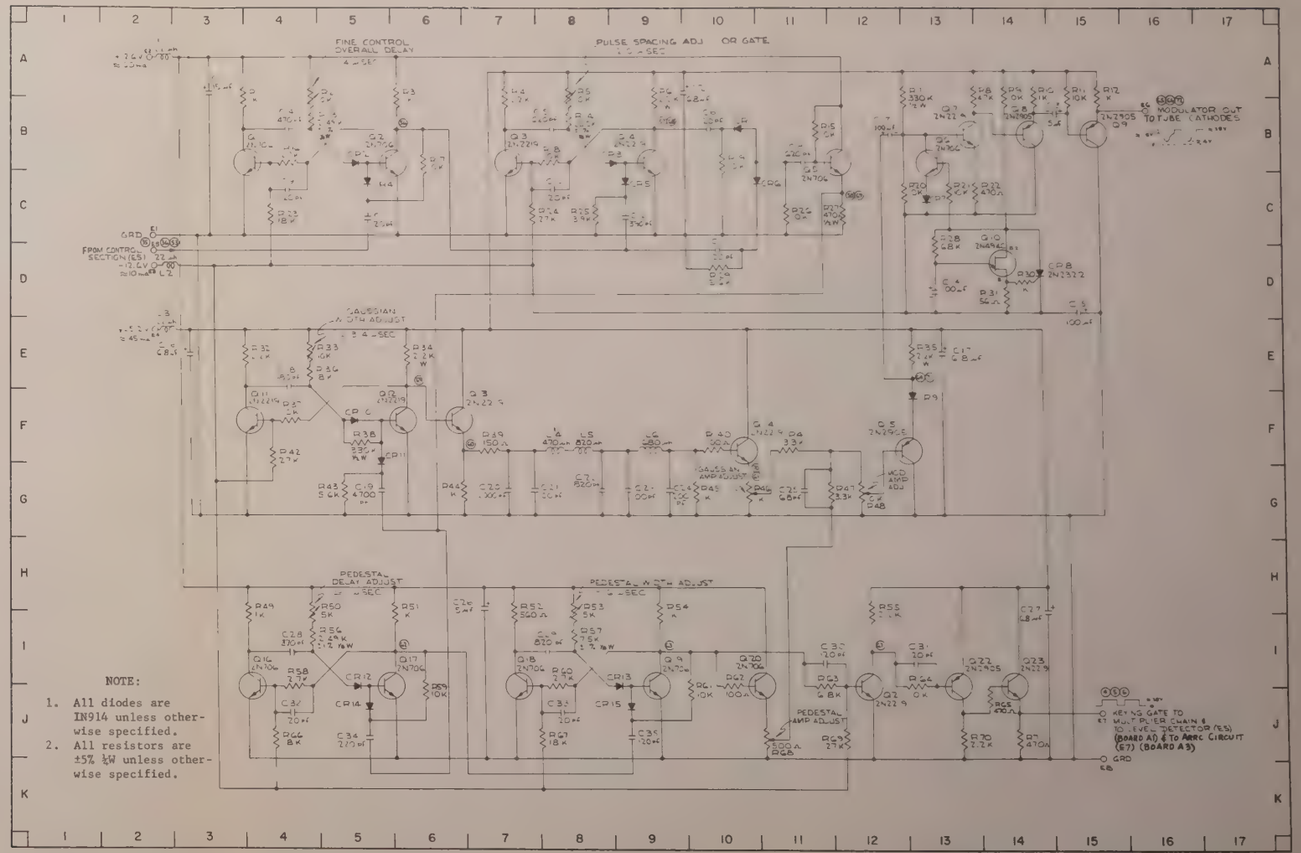


Figure 5-50. Encoder/Modulator Section (Circuit Board, 1A2A1A1A5), Schematic Diagram

PART LOCATION INDEX

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
C1	B9	C36	G4	L7	B14	R9	C2
C2	B12	C37	H7	L8	B14	R10	C14
C3	B14	C38	I8	L9	B8	R11	C6
C4	B15	C39	I8	L10	B11	R12	C3
C5	B10	C40	I7	L11	B13	R13	C7
C6	B11	C41	J6	L12	B15	R14	C8
C7	B12	C42	J7	L13	C9	R15	C8
C8	B14	C43	J8	L14	C4	R16	D7
C9	B15	C44	J8	L15	C5	R17	D10
C10	B3	CR1	C4	L16	C10	R18	D11
C11	B9	CR2	C5	L17	C14	R19	D12
C12	C11	CR3	C7	L18	C5	R20	D12
C13	C13	CR4	D5	L19	C4	R21	D13
C14	C16	CR5	D4	L20	C5	R22	D14
C15	C3	CR6	D13	L21	F5	R23	D14
C16	C5	CR7	G5	L22	F6	R24	D15
C17	C7	CR8	G9	L23	F8	R25	D15
C18	C13	CR9	J9	L24	G6	R26	E6
C19	C6	E1	A15	L25	I6	R27	F7
C20	C8	E2	B16	L26	I8	R28	G4
C21	C9	E3	C2	L27	J6	R29	G5
C22	C10	E4	E1	Q1	C8	R30	G6
C23	C3	E5	E2	Q2	C11	R31	G9
C24	C5	E7	G11	Q3	C13	R32	H8
C25	D3	FL1	A15	Q4	C14	R33	I6
C26	D6	FL2	B15	Q5	E6	R34	I7
C27	D7	FL3	E6	Q6	J7	R35	I7
C28	D11	J1	J10	R1	B14	R36	J9
C29	D13	J2	G11	R2	B14	T1	C3
C30	D13	J3	G12	R3	B7	T2	C4
C31	E7	L2	A15	R4	B8	TP1	C6
C32	F7	L3	B9	R5	B10	TP2	D13
C33	G5	L4	B12	R6	B11	TP3	G4
C34	G8	L5	B15	R7	B12	Z1	I9
C35	G8	L6	A16	R8	B13	Z2	F10

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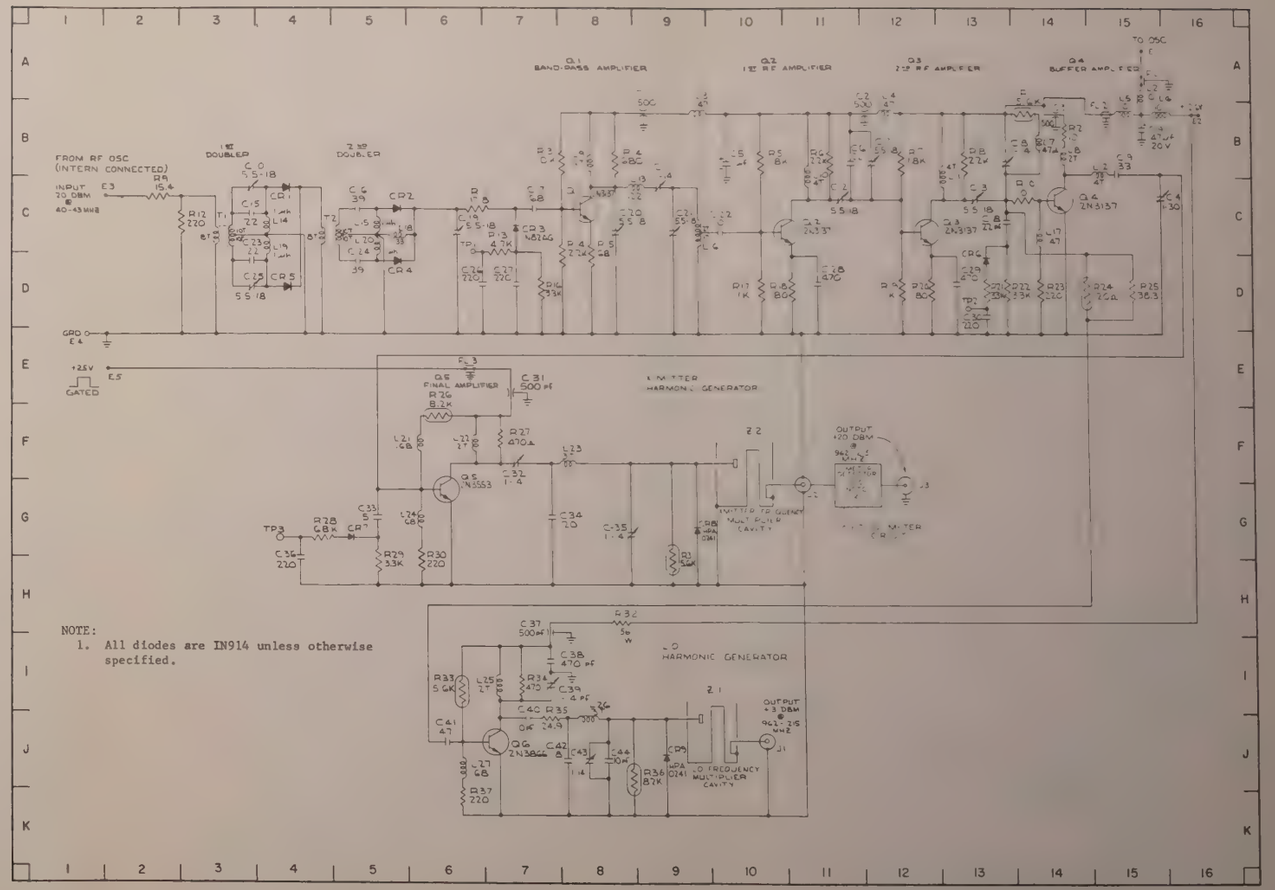
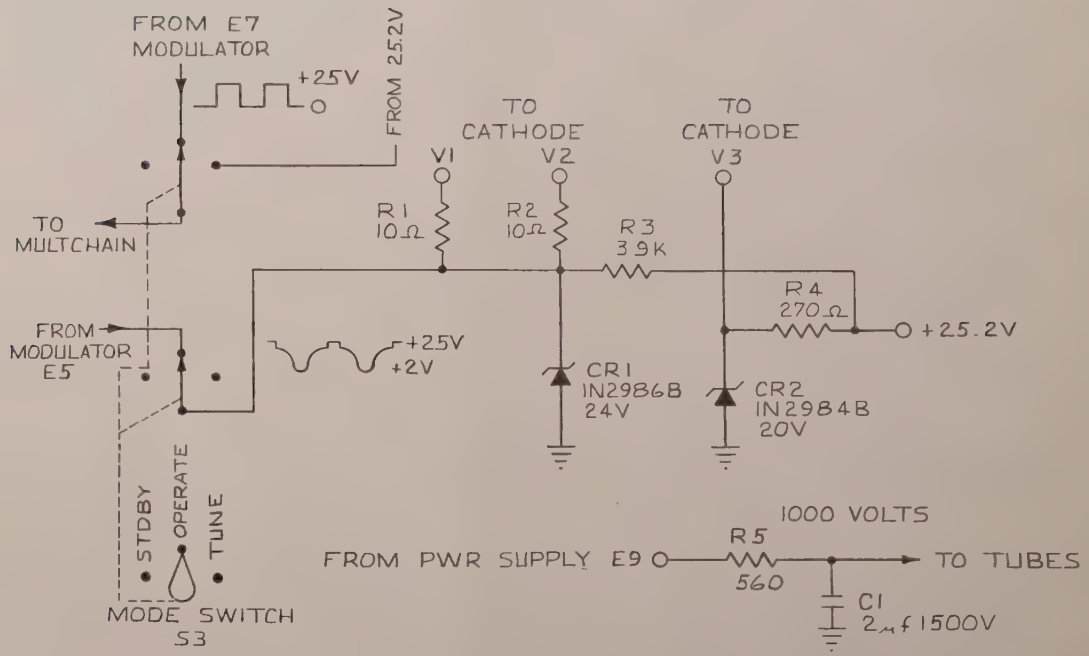
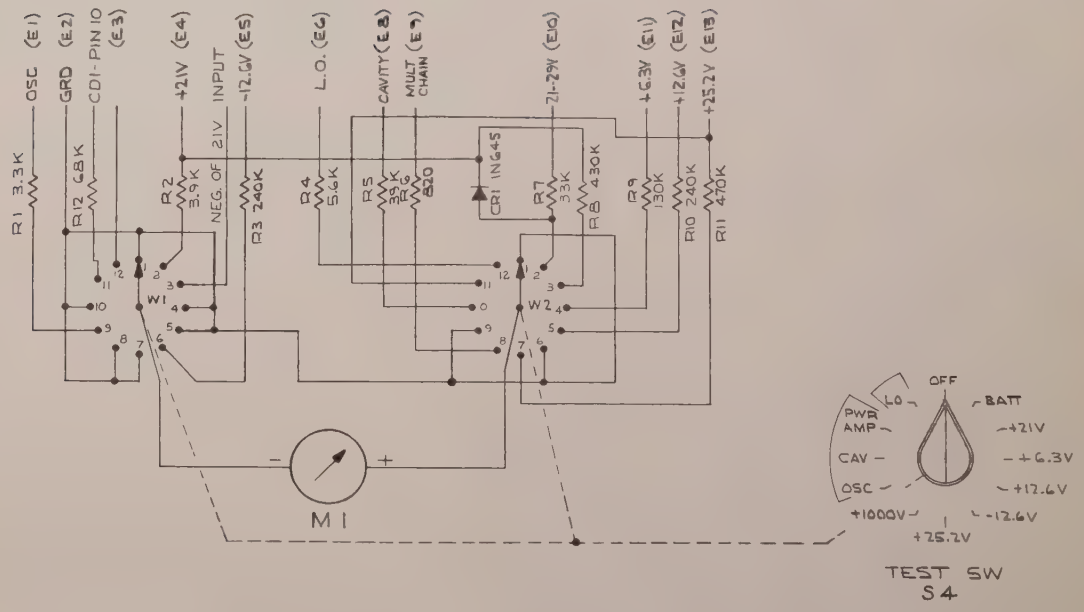


Figure 5-52. Frequency Multiplier Chain (Circuit Board, 1A2A1A3), Schematic Diagram



NOTE:
1. Switch S3 is mounted on the front panel.

Figure 5-54. Cathode Biasing and High Voltage Filter Circuits (1A2A1A6), Schematic Diagram



NOTE:
Test meter circuit switch S4 is mounted on the front panel.

Figure 5-55. Test Meter Circuit (1A2A1A6) Schematic Diagram

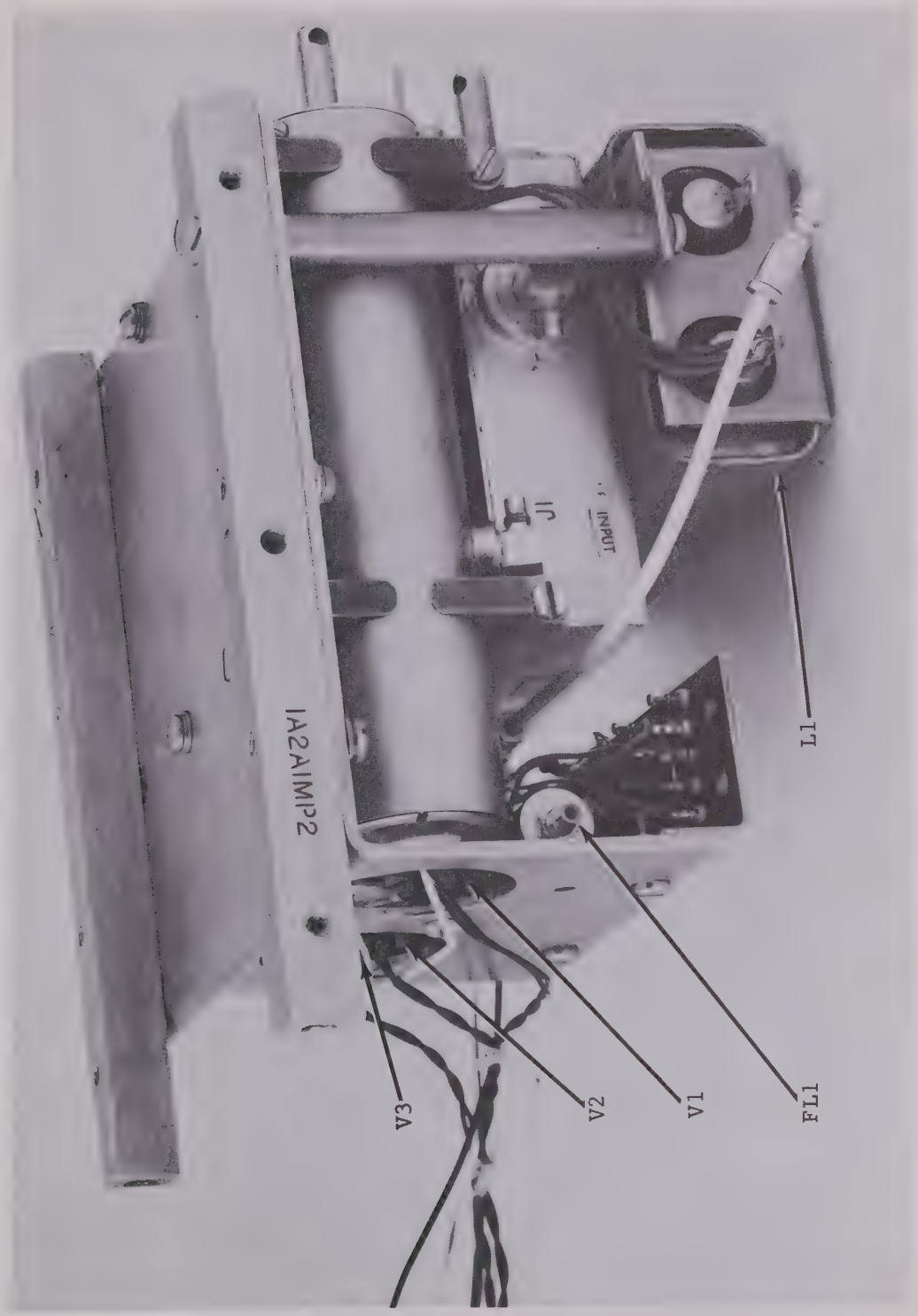


Figure 5-58. Preselector and RF Power Amplifier Subassembly, (1A2A1A5A1), Showing Inductor, Low-Pass Filter and Tube Locations

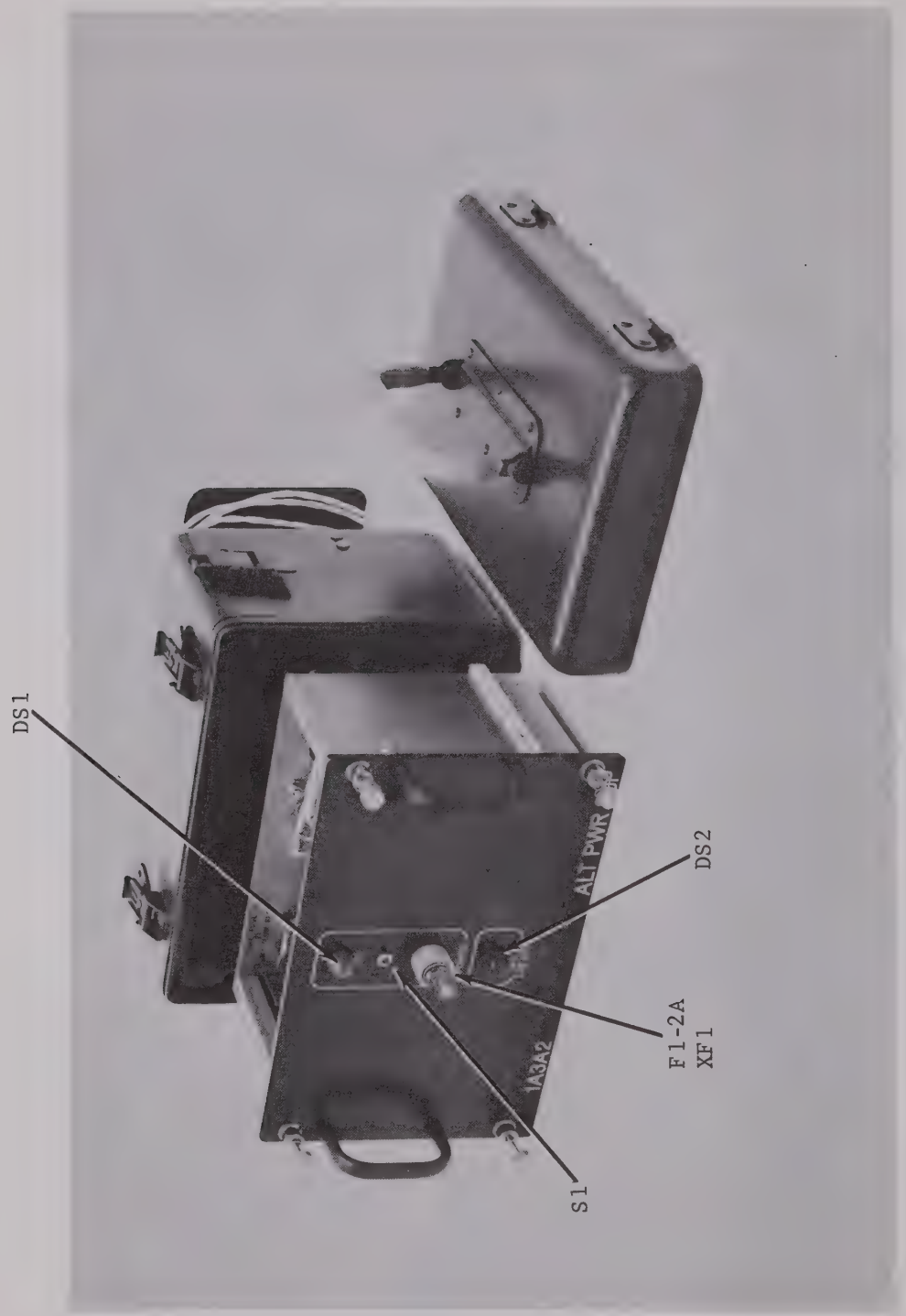


Figure 5-59. Alternate Power Supply, Chassis Removed from the Case, (1A3A2), Showing Lamp Bulb, Switch, Fuse and Fuse Holder Locations

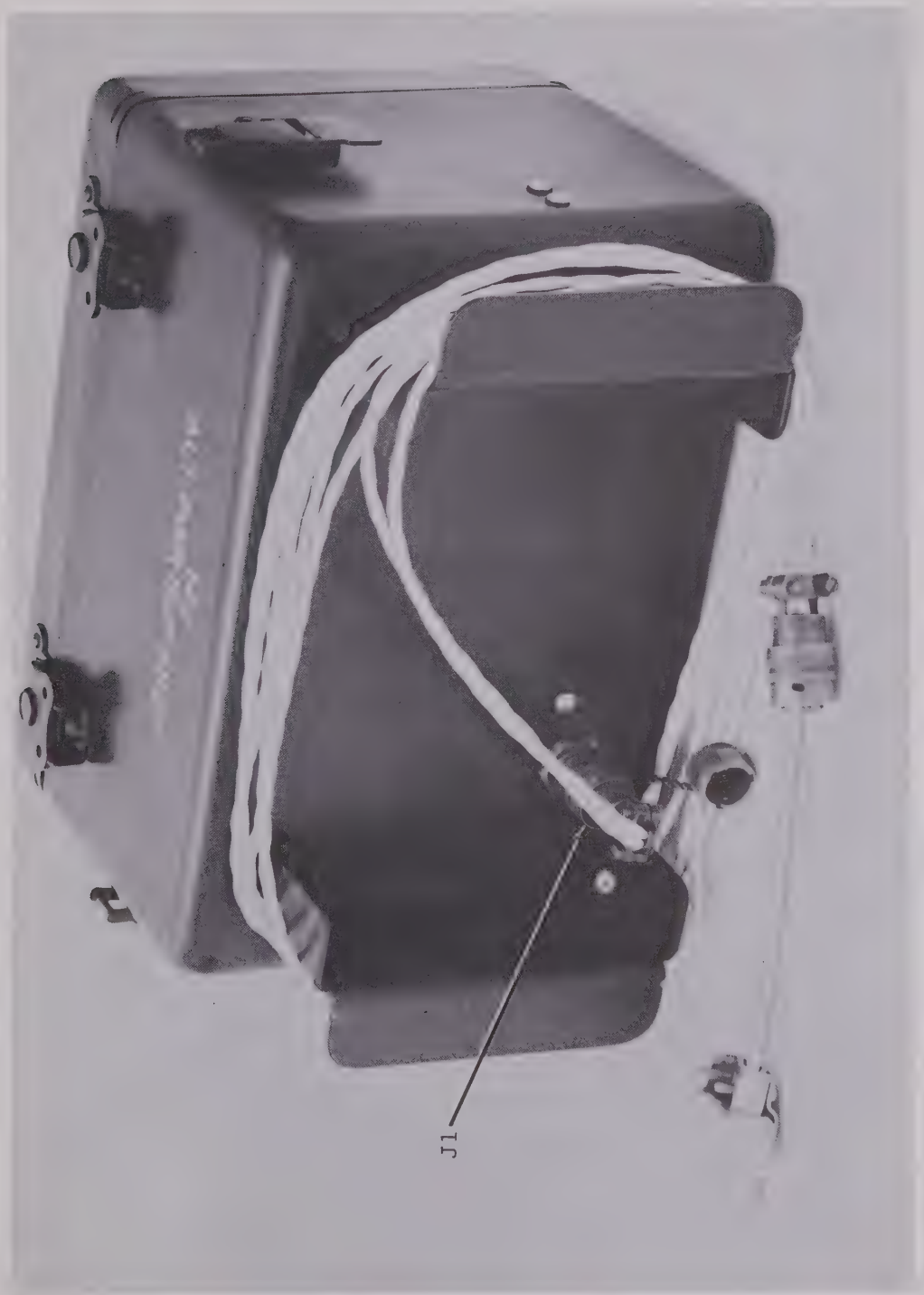


Figure 5-60. Alternate Power Supply, Rear View, (1A3A2), Showing Connector Location

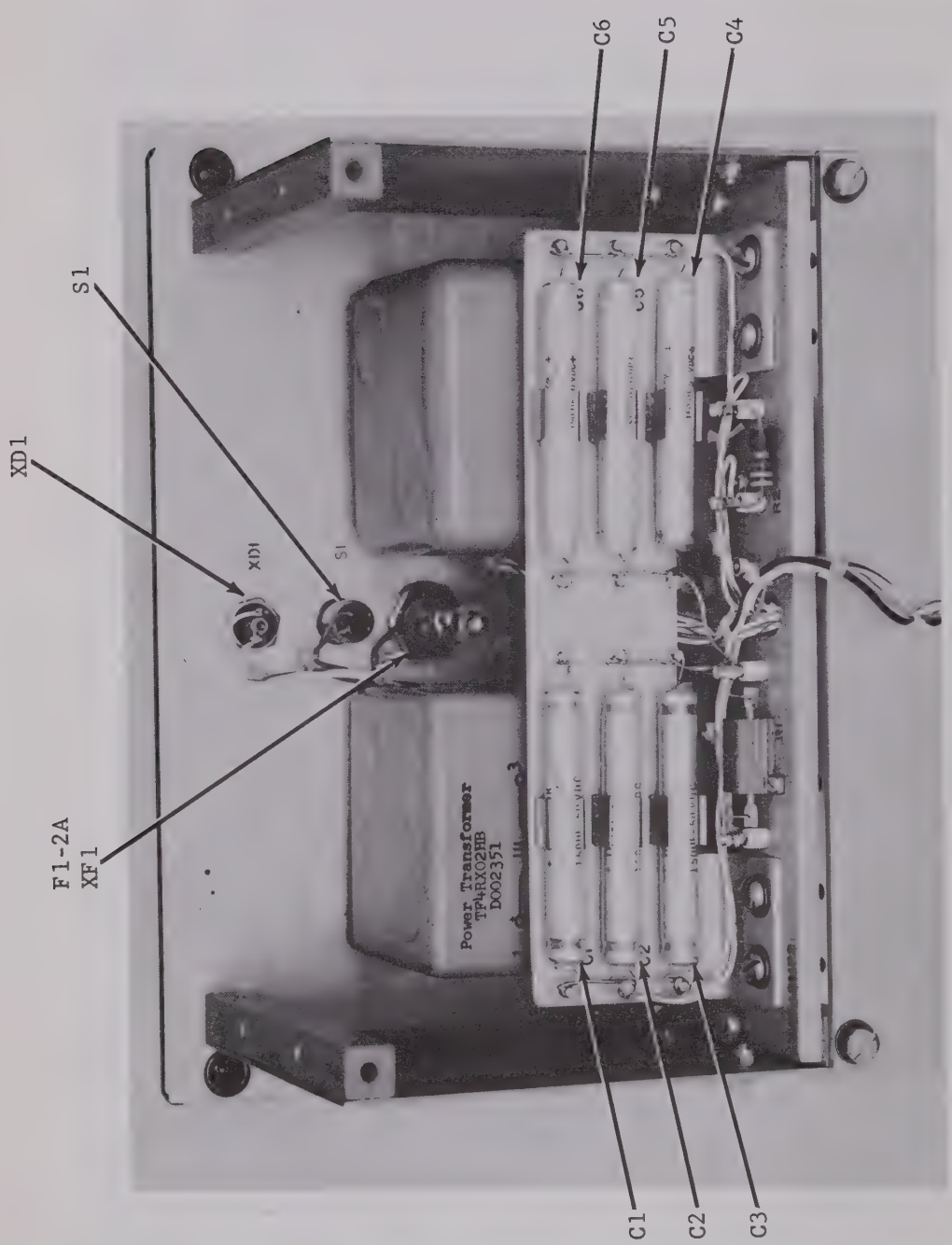


Figure 5-61. Alternate Power Supply, Chassis Back View, (1A3A2), Showing Capacitor, Lamp Holder, Fuse and Fuse Holder Locations

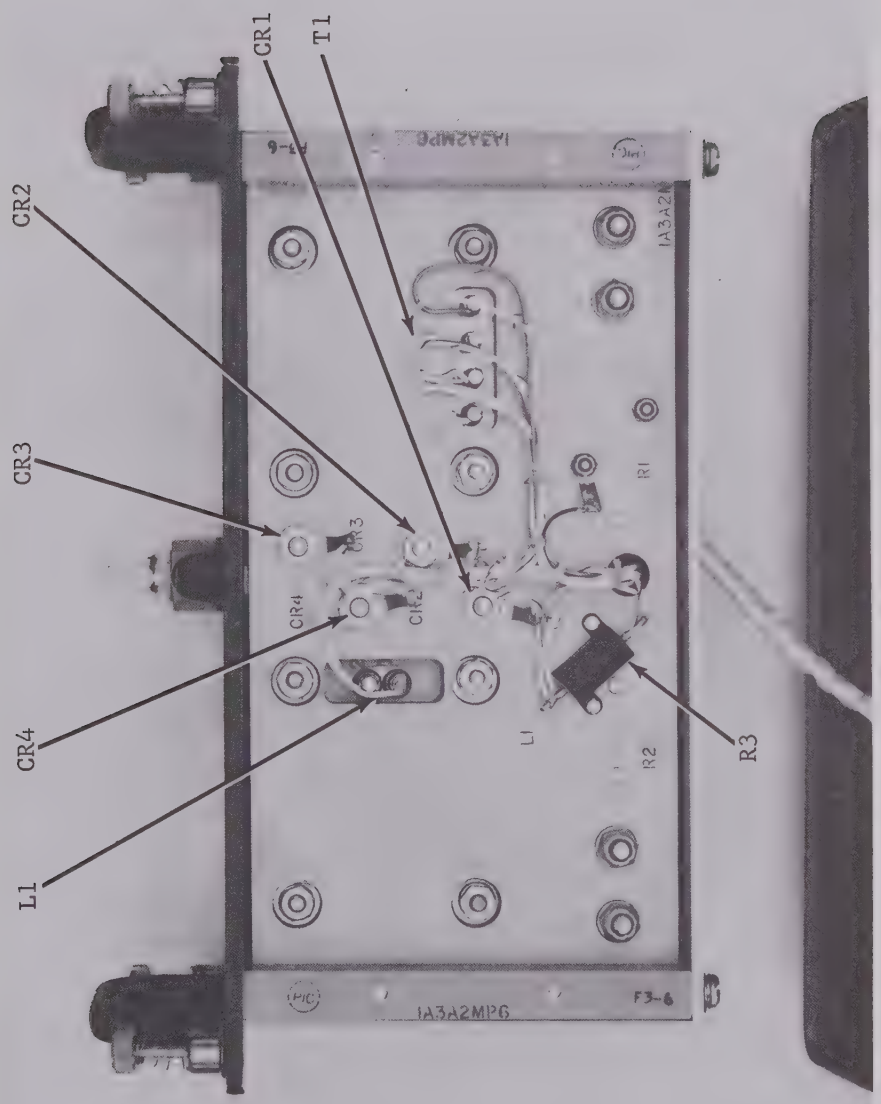


Figure 5-62. Alternate Power Supply, Chassis Bottom View, (1A3A2), Showing Diode, Inductor, Resistor and Transformer Locations

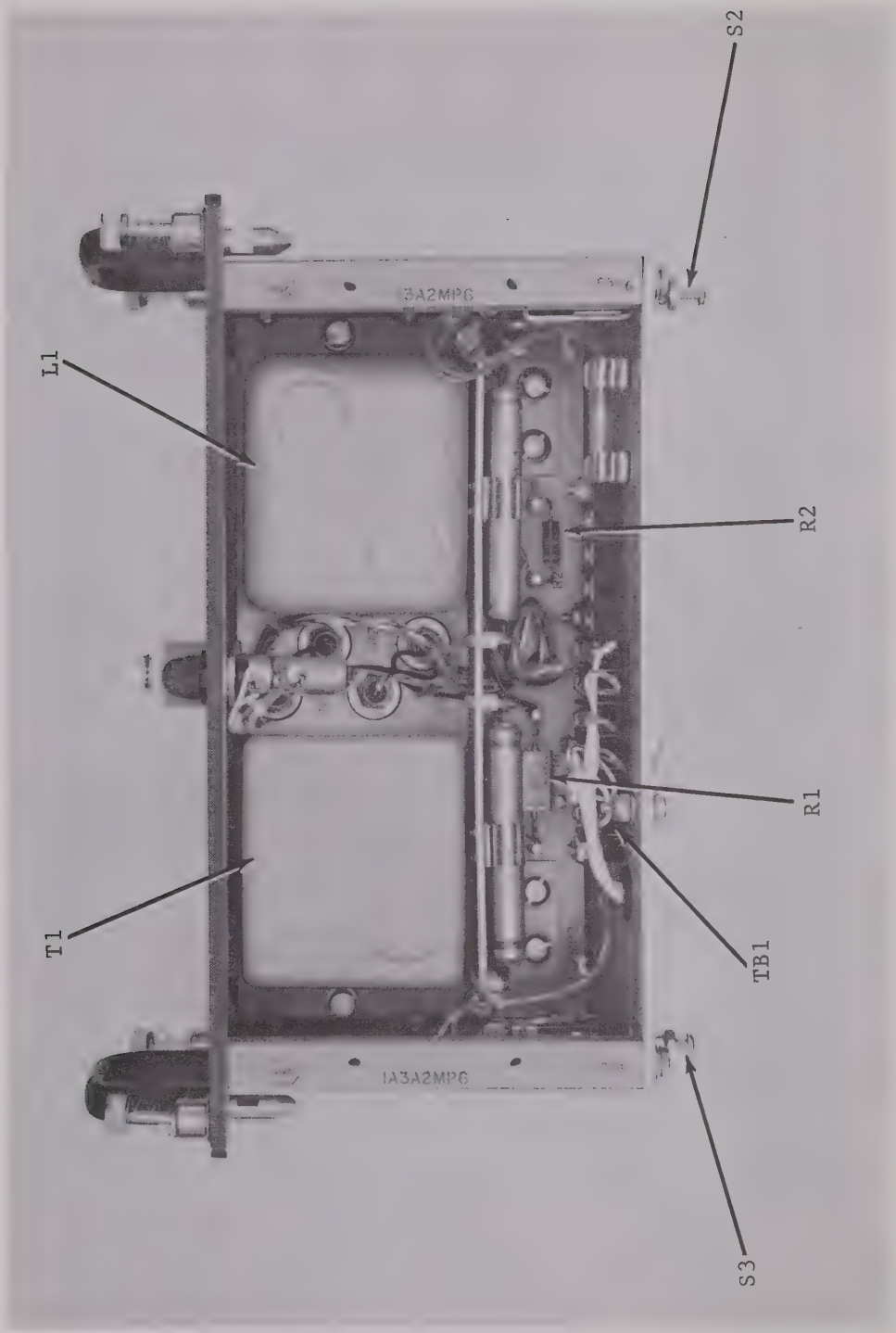


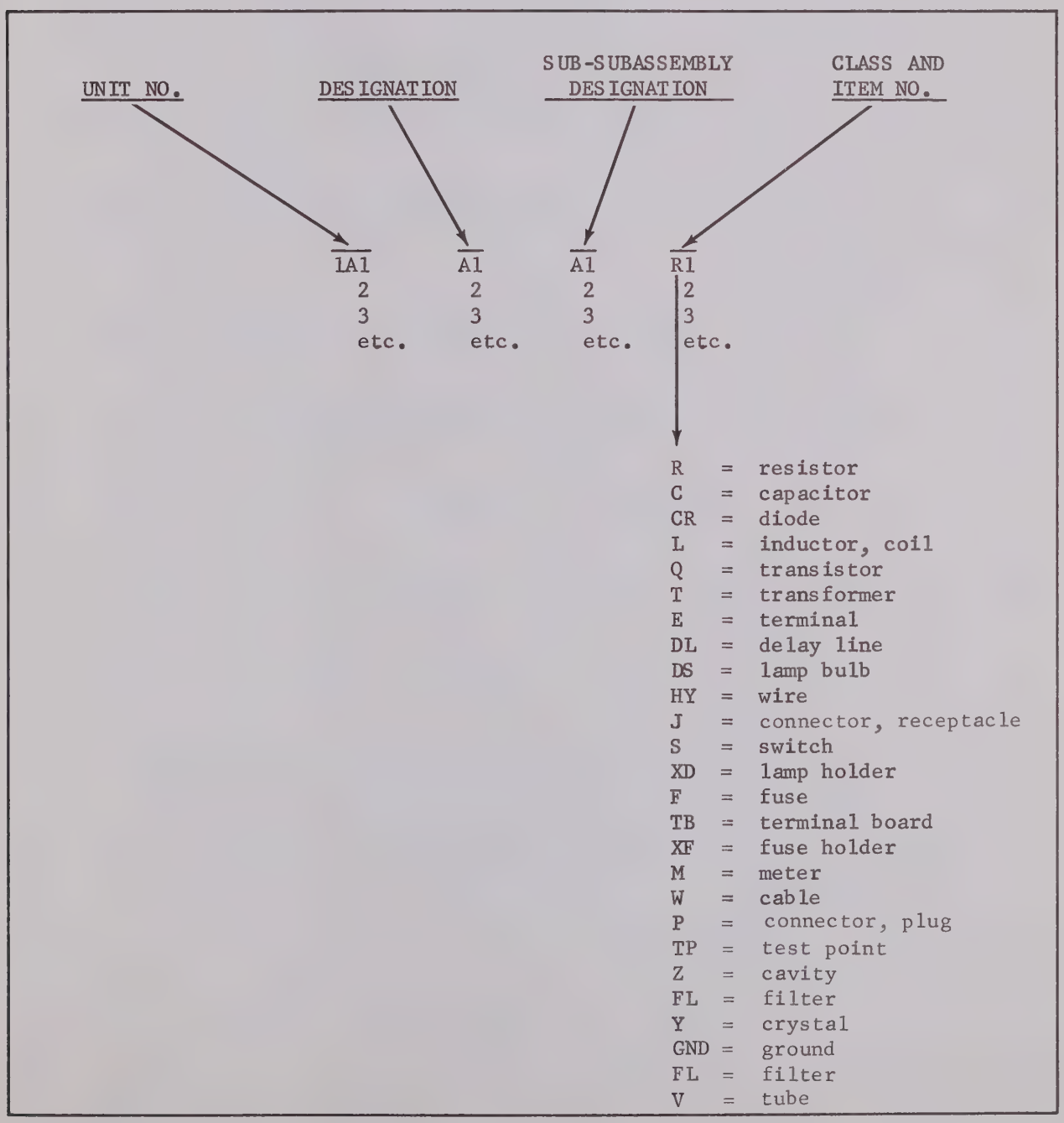
Figure 5-63. Alternate Power Supply, Chassis Top View, Showing Resistor, Inductor, Switch, Terminal Board, and Transformer Locations

SECTION 6

PARTS LIST

6-1. INTRODUCTION.

This section presents a complete listing of parts for maintenance purposes. The manual designation for parts is as follows:



6-2. LIST OF UNITS.

Table 6-1 presents a list of units comprising the AN/TRN-22 (XN-1) system.

6-3. MAINTENANCE PARTS LIST.

Table 6-2 presents a list of those units and subunits that have maintenance parts. Figures are referenced in Table 6-2 to show locations of the various parts. Those parts not previously presented pictorially in Sections 1 through 5 are presented in this section. (Figures 5-5 through 5-41)

TABLE 6-1. LIST OF UNITS

UNIT NO.	QTY.	NAME OF UNIT	DESIGNATION	COLLOQUIAL NAME	PAGE
1	1	Antenna Assembly	1A1/TRN-22 (XN-1)	Antenna	5-13
1	1	Transponder Assembly	1A2/TRN-22 (XN-1)	Transponder	3-19
1	1	Alternate Power Supply	1A3/TRN-22 (XN-1)	Power Supply	3-22
1	1	Battery	1A4/BB-451/u/ TRN-22 (XN-1)	Battery	3-19
1	1	Tripod Assembly	1A5/TRN-22 (XN-1)	Tripod	3-9

TABLE 6-2 MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A1		ANTENNA DRIVE ASSEMBLY	E002450, and Fig 5-5
1A1B1	GI	Motor, Globe Industries, Inc. Dayton, Ohio Part No. 261A105*	Antenna Assembly
1A1A5	GI	Speed Control, Globe Industries, Inc. Dayton, Ohio Part No. 261A105 *	Antenna Assembly
1A1A4		North Reference Trigger	
DS1	CM	Lamp, Chicago Miniature CM8-363	
J1	GRFF	Connector GRFF #4116-0001	
J2	NACO	Connector, Type N Supplied with Antenna Central Array Assy. Nevada Antenna Company	
J3	BDX	Connector Bendix MS3114E-10-6P	
Q1	FC	Phototransistor Fairchild FPM 100	
		*Same Part Number From Vendor	

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2		AN/TRN-22 (XN-1) CABLING TRANSPONDER	Assemblies
	AMP	Cable. RG188 2 ft	
A2J1	STC	Connector, UG-1465/u	Power Supply
Card A4, E16		Connector, Solder terminal	Card Rack
	AMP	Cable, RG188 7 in	
A2J2	STC	Connector, UG-1465/u	Antenna Connector
A5J8	STC	Connector, UG-1465/u	Preselector
	AMP	Cable, RG188 8 in	
A3J1	STC	Connector, UG-1465/u	Mult Chain
A4J2	STC	Connector, Sealectro 59-007-0000	Receiver
	AMP	Cable, RG188 8 in	
A3J3	STC	Connector, UG-1465/u	Mult Chain
A5J1	STC	Connector, UG-1465/u	Preselector
	AMP	Cable, RG188 6 in	
A4J1	STC	Connector, Sealectro 59-007-0000	Receiver
A5J12	STC	Connector, UG-1466/u	Preselector
A5J2 A5J3		Cable, Supplied with Power Tube Assembly	Preselector
	AMP	Cable RG188 6 in	
A5J11	STC	Connector, UG-1466/u	Low Pass Filter
A5J10	STC	Connector, UG-1465/u	Preselector

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2			
W5	AMP	Cable, RG 225/U	
P1	KE	Connector, UG 21C/U	Transponder
P2	KE	Connector, UG 21C/U	Antenna
W6	AMP	Cable, RG 141/U	
P1	MTK	Connector, Montek #B001355	Transponder
P2	MTK	Connector, Montek #B001900	Antenna
W7	HWC	Cable, Hitemp Wire Co. 2TX20-1930 STJ	
P1	BDX	Connector, MS3116E-10-6S (SR)	Transponder
WHT (+) BLK (-)		Connector, Open	Ext Pwr Supply

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A1		LEVEL DETECTOR	C00398; Figs 5-7, -8, -9, -46
C1	SPR	Capacitor, Fixed Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	Q3 Emitter Coupling
C2	SPR	Capacitor, Fixed Solid Electrolyte (Tantalum) 6.8 µf ±10% 35V DCW CS13BF685K	R1 Filtering
C3	SPR	Capacitor, Fixed Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	Q2 Emitter Coupling
C4	SPR	Capacitor, Fixed Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	Q3 Emitter Coupling
C5	CD	Capacitor, Fixed Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q8 Base Speed Up
C6	CD	Capacitor, Fixed Mica Dielectric 1000 pf ±5% 500V DCW CM06D102J03	CR2 Cathode Peak Detector
C7	SPR	Capacitor, Fixed Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE152K	Q6 Collector Coupling
C8	CD	Capacitor, Fixed Mica Dielectric 100 pf ±5% 500V DCW CM05D10J03	Q9 Emitter
C9	SPR	Capacitor, Fixed Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	Q10 Emitter Coupling
C10	SPR	Capacitor, Fixed Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	R25 Filtering
C11	SPR	Capacitor, Fixed Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	R26 Filtering
C12	CD	Capacitor, Fixed Mica Dielectric 270 pf ±5% 500V DCW CM05D271J03	Q11 Collector MVB Timing
C13	CD	Capacitor, Fixed Mica Dielectric 1000 pf ±5% 500V DCW CM06D102J03	Q12 Collector MVB Timing
C14	CD	Capacitor, Fixed Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q11 Base Speed Up
C15	CD	Capacitor, Fixed Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q12 Base Speed Up
C16	CD	Capacitor, Fixed Mica Dielectric 56 pf ±5% 500V DCW CM05D560J03	CR7 Cathode Coupling
C17	CD	Capacitor, Fixed Mica Dielectric 56 pf ±5% 500V DCW CM05D560J03	CR9 Cathode Coupling
C18	CD	Capacitor, Fixed Mica Dielectric 56 pf ±5% 500V DCW CM05D560J03	CR8 Cathode Coupling

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A1			
CR1	GE	Diode 1N3713 Tunnel	Q6 Tunnel Diode Pick Off
CR2	TI	Diode 1N914	Q9 Base Peak Detector
CR3	TI	Diode 1N914	Q9 Base Temperature Compensating
CR4	MOT	Diode 1N823 Zener	R20 Voltage Stand Off
CR5	TI	Diode 1N914	Q13 Base Clamping
CR6	TI	Diode 1N914	Q14 Base Clamping
CR7	TI	Diode 1N914	Q3 Base Drive
CR8	TI	Diode 1N914	Q14 Base Drive
CR9	TI	Diode 1N914	Q14 Base Drive
DL-1	ESC	Delay line Tapped 3.5μsec 500Ω ESC Corporation # 30A66	
E1	USC	Terminal Stud. USECO No. 2020B-1	Ground Terminal
E2	USC	Terminal Stud. USECO No. 2020B-1	+12.6V
E3	USC	Terminal Stud. USECO No. 2020B-1	-12.6V
E4	USC	Terminal Stud. USECO No. 2020B-1	+25.2V
E5	USC	Terminal Stud. USECO No. 2020B-1	Blanking Gate
E6	USC	Terminal Stud. USECO No. 2020B-1	Video Input
E7	USC	Terminal Stud. USECO No. 2020B-1	Step Adjust Test Point
E8	USC	Terminal Stud. USECO No. 2020B-1	Output to Decoder

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A1 E11	USC	Terminal Stud. USECO No. 2020B-1	6μsec MVB Test Point
Q1	MOT	Transistor 2N930	Dual Emitter Follower
Q2	MOT	Transistor 2N2219	Dual Emitter Follower
Q3	MOT	Transistor 2N2219	Emitter Follower
Q4	MOT	Transistor 2N2219	Blanking Gate
Q5	TI	Transistor 2N706	Emitter Follower
Q6	RCA	Transistor 2N1225	Tunnel Diode Pick Off Inverter
Q7	MOT	Transistor 2N2219	Reset
Q8	TI	Transistor 2N706	Inverter
Q9	MOT	Transistor 2N930	Dual Emitter Follower
Q10	MOT	Transistor 2N2219	Dual Emitter Follower
Q11	TI	Transistor 2N706	Reset Pulse MV
Q12	TI	Transistor 2N706	Reset Pulse MV
Q13	TI	Transistor 2N706	Reset Delay MV
Q14	TI	Transistor 2N706	Reset Delay MV
R1	OHM	Resistor, Fixed Composition 10 ±10% 1/4 Watt RC07GF100K	25.2V Filtering on E4
R2	IRC	Resistor, Fixed Film 510 ±5% 1/4 Watt RL07AD511J	DL-1 Terminating
R3	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	Q2 Emitter
R4	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	Q6 Emitter
R5	IRC	Resistor, Fixed Film 150K ±5% 1/4 Watt RL07AD154J	Q3 Base Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A1			
R6	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	Q3 Base Limiting
R7	IRC	Resistor, Fixed Film 470 ±5% 1/4 Watt RL07AD471J	Q8 Collector
R8	IRC	Resistor, Fixed Film 6.8K ±5% 1/4 Watt RL07AD682J	Q4 Base Limiting
R9	IRC	Resistor, Fixed Film 10K ±5% 1/4 Watt RL07AD103J	Q3 Base Bias
R10	IRC	Resistor, Fixed Film 100 ±5% 1/4 Watt RL07AD101J	Q7 Collector
R11	IRC	Resistor, Fixed Film 18K ±5% 1/4 Watt RL07AD183J	Q4 Base Bias
R12	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	Q3 Emitter
R13	IRC	Resistor, Fixed Film 470 ±5% 1/4 Watt RL07AD471J	Q7 Base Limiting
R14	IRC	Resistor, Fixed Film 2.7K ±5% 1/4 Watt RL07AD272J	Q8 Base Coupling
R15	IRC	Resistor, Fixed Film 470 ±5% 1/4 Watt RL07AD471J	Q5 Emitter
R16	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	Q5 Base Limiting
R17	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	CR4 Voltage Delay Network
R18	IRC	Resistor, Fixed Film 10K ±5% 1/4 Watt RL07AD103J	Q6 Collector
R19	IRC	Resistor, Fixed Film 18K ±5% 1/4 Watt RL07AD183J	Q8 Base Bias
R20	TI	Resistor, Fixed Film 10K ±1% 1/8 Watt RN60C1002F	CR4 Voltage Delay Network
R21	BRN	Resistor, Variable 2K Pot Bourns 3260H-1-202	Step Adjust Voltage Delay
R22	IRC	Resistor, Fixed Film 1.5K ±5% 1/4 Watt RL07AD152J	CR4 Voltage Delay Network
R23	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	Q10 Emitter
R24	BRN	Resistor, Variable 1K Pot Bourns 3260H-1-102	Tracking Adjust
R25	OHM	Resistor, Fixed Composition 10 ±10% 1/4 Watt RC07GF100K	-12.6V Filtering
R26	OHM	Resistor, Fixed Composition 10 ±10% 1/4 Watt RC07GF100K	+12.6V Filtering

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A1			
R27	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	Q11 Collector
R28	TI	Resistor, Fixed Film 4.87K ±1% 1/8 Watt RN60C4871F	Q13 MVB Timing 1 μsec
R29	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	Q13 Collector
R30	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	Q12 Collector
R31	BRN	Resistor, Variable 10K Pot Bourns 3260H-1-103	Q14 MVB Timing 6 μsec
R32	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	Q14 Collector
R33	TI	Resistor, Fixed Film 4.87K ±1% 1/8 Watt RN60C4871F	Q14 MVB Timing 6 μsec
R34	IRC	Resistor, Fixed Film 2.7K ±5% 1/4 Watt RL07AD272J	Q11 Base Coupling
R35	IRC	Resistor, Fixed Film 2.7K ±5% 1/4 Watt RL07AD272J	Q12 Base Coupling
R36	IRC	Resistor, Fixed Film 18K ±5% 1/4 Watt RL07AD183J	Q11 Base Bias
R37	IRC	Resistor, Fixed Film 10K ±5% 1/4 Watt RL07AD103J	CR7 Cathode
R38	IRC	Resistor, Fixed Film 18K ±5% 1/4 Watt RL07AD183J	Q12 Base Bias
R39	IRC	Resistor, Fixed Film 10K ±5% 1/4 Watt RL07AD103J	CR8 Cathode
R40	IRC	Resistor, Fixed Film 10K ±5% 1/4 Watt RL07AD103J	CR9 Cathode

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A1		R. F. MONITOR CIRCUIT BOARD	C00399; Figs 5-7, -8, -9, -53
C19	AER	Capacitor, Fixed, Paper Dielectric .1 µf ±10% 100 VDC W CP05A1KB104K3	R45, Filter Network
C20	SPR	Capacitor, Fixed, Solid Electrolyte 1. µf ±10% 35 VDC W CS13BF105K	Q16, Base Coupling
C21	SPR	Capacitor, Fixed, Solid Electrolyte 1. µf ±10% 35 VDC W CS13BF105K	Q15, Base Coupling
CR10	TI	Diode IN914	Q16, Collector
E1	USC	Terminal Stud. USECO 2020B-1	Ground Terminal
E4	USC	Terminal Stud. USECO 2020B-1	+25.2V input
E9	USC	Terminal Stud. USECO 2020B-1	R.F. Monitor Input
E10	USC	Terminal Stud. USECO 2020B-1	R.F. Monitor Output
Q15	MOT	Transistor 2N2219	Amplifier
Q16	TI	Transistor 2N1132	Emitter Follower
R41	IRC	Resistor, Fixed, Film 100K ±5% 1/4 Watt RL07AD104J	Q15, Base Bias
R42	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q15, Collector
R43	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q16, Base Bias
R44	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q16, Emitter

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A1			
R45	IRC	Resistor, Fixed, Film 68K ±5% 1/4 Watt RL07AD683J	C19, Filter Network
R46	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	C21, Matching
R47	IRC	Resistor, Fixed, Film 4.7K ±5% 1/4 Watt RL07AD472J	Q15, Base Bias
R48	IRC	Resistor, Fixed, Film 220Ω ±5% 1/4 Watt RL07AD221J	Q15, Emitter
R49	IRC	Resistor, Fixed, Film 330K ±5% 1/2 Watt RL20AD334J	Q16, Base Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A2		DECODER LOGIC CIRCUIT	E00401, Figs 5-10, -11, -12, -47
C1	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20 VDC W CS13BE156K	R7, Filtering
C2	CD	Capacitor, Fixed, Mica Dielectric 22 pf ±5% 500 VDC W CM05D220J03	Q3, Base Speed Up
C3	CD	Capacitor, Fixed, Mica Dielectric 22 pf ±5% 500 VDC W CM05D220J03	Q2, Base Speed Up
C4	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 1 µf ±10% 35 VDC W CS13BF105K	Q3, Collector Coupling
C5	CD	Capacitor, Fixed, Mica Dielectric 1000 pf ±5% 500 VDC W CM06D102J03	R9, Timing
C6	CD	Capacitor, Fixed, Mica Dielectric 56 pf ±5% 500 VDC W CM05D560J03	R12, Timing
C7	CD	Capacitor, Fixed, Mica Dielectric 22 pf ±5% 500 VDC W CM05D220J03	R19, Coupling
C8	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500 VDC W CM05D121J03	Q6, Base Speed Up
C9	CD	Capacitor, Fixed, Mica Dielectric 390 pf ±5% 500 VDC W CM05D391J03	CR9, Cathode Coupling
C10	CD	Capacitor, Fixed, Mica Dielectric 390 pf ±5% 500 VDC W CM05D391J03	CR10, Cathode Coupling
C11	CD	Capacitor, Fixed, Mica Dielectric 56 pf ±5% 500 VDC W CM05D560J03	CR11, Cathode Coupling
C12	CD	Capacitor, Fixed, Mica Dielectric 390 pf ±5% 500 VDC W CM05D391J03	CR8, Cathode Coupling
C13	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15µf ±10% 20 VDC W CS13BE156K	R34, Filtering
C14	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20 VDC W CS13BE156K	R35, Filtering
C15	CD	Capacitor, Fixed, Mica Dielectric 560 pf ±5% 500 VDC W CM06D561J03	R37, Timing
C16	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500 VDC W CM05D121J03	Q11, Base Speed Up

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A2			
C17	CD	Capacitor, Fixed, Mica Dielectric 56 pf ±5% 500 VDC W CM05D560J03	CR13, Cathode Coupling
C18	CD	Capacitor, Fixed, Mica Dielectric 1000 pf ±5% 500 VDC W CM06D102J03	Q14, Emitter Bypass
C19	CD	Capacitor, Fixed, Mica Dielectric 1000 pf ±5% 500 VDC W CM06D102J03	Q17, Emitter Bypass
CR1	TI	Diode IN914	R30 AND GATE
CR2	TI	Diode IN914	R14, NAND GATE
CR3	TI	Diode IN914	Q10, Base
CR4	TI	Diode IN914	Q7, Base Clamping
CR5	TI	Diode IN914	Q9, Base Clamping
CR6	TI	Diode IN914	R30 AND GATE
CR7	TI	Diode IN914	Q7, Base Drive
CR8	TI	Diode IN914	Q9, Base Drive
CR9	TI	Diode IN914	Q2, Base Drive
CR10	TI	Diode IN914	Q3, Base Drive
CR11	TI	Diode IN914	R14, NAND GATE
CR12	TI	Diode IN914	Q12, Base Clamping
CR13	TI	Diode IN914	Q12, Base Drive
CR14	GE	Diode, Tunnel IN3713	Q14, Base
CR15	TI	Diode IN914	Q14, Emitter Standoff
CR16	GE	Diode, Tunnel IN3713	Q17, Base
CR17	TI	Diode IN914	Q17, Emitter Standoff

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION		LOCATING FUNCTION
1A2A1A1A2				
DL1	ESC	Delay Line. 15 μ sec. Tapped ESC Corporation # 47-03		
E1	USC	Terminal, Stud.	USECO 2020B-1	Ground Terminal
E2	USC	Terminal, Stud.	USECO 2020B-1	+12.6 volts
E3	USC	Terminal, Stud.	USECO 2020B-1	-12.6 volts
E4	USC	Terminal, Stud.	USECO 2020B-1	Input from Level Detector
E5	USC	Terminal, Stud.	USECO 2020B-1	Output to ARRC
Q1	MOT	Transistor	2N869A	PNP, Emitter Follower
Q2	TI	Transistor	2N706	1/2 Flip-Flop
Q3	TI	Transistor	2N706	1/2 Flip-Flop
Q4	MOT	Transistor	2N869A	PNP, Emitter Follower
Q5	MOT	Transistor	2N869A	PNP, Emitter Follower
Q6	TI	Transistor	2N706	7μ sec Multivibrator
Q7	TI	Transistor	2N706	7μ sec Multivibrator
Q8	TI	Transistor	2N706	.2μ sec Multivibrator
Q9	TI	Transistor	2N706	.2μ sec Multivibrator

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A2			
Q10	TI	Transistor 2N706	Inverter
Q11	TI	Transistor 2N706	4μ sec Multivibrator
Q12	TI	Transistor 2N706	4μ sec Multivibrator
Q13	TI	Transistor 2N706	Emitter Follower
Q14	TI	Transistor 2N706	Inverter Amplifier
Q15	MOT	Transistor 2N869A	PNP, Emitter Follower
Q16	TI	Transistor 2N706	Emitter Follower
Q17	TI	Transistor 2N706	Inverter Amplifier
Q18	MOT	Transistor 2N869A	PNP, Emitter Follower
R1	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q1, Base Bias
R2	IRC	Resistor, Fixed, Film 220Ω ±5% 1/4 Watt RL07AD221J	Q1, Emitter
R3	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q2, Collector
R4	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q3, Collector
R5	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q4, Base Bias
R6	IRC	Resistor, Fixed, Film 220Ω ±5% 1/4 Watt RL07AD221J	Q4, Emitter
R7	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD471J	Q5, Emitter

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A2			
R8	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q6, Collector
R9	TI	Resistor, Fixed, Film 10K ±1% 1/8 Watt RN60C1002F	C5, Timing
R10	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q7, Collector
R11	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q8, Collector
R12	TI	Resistor, Fixed, Film 2.49K ±1% 1/8 Watt RN60C2491F	C6, Timing
R13	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q9, Collector
R14	IRC	Resistor, Fixed, Film 3.9K ±5% 1/4 Watt RL07AD392J	CR2, Bias
R15	IRC	Resistor, Fixed, Film 560Ω ±5% 1/4 Watt RL07AD561J	Q10, Collector
R16	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q3, Base Coupling
R17	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q2, Base Coupling
R18	IRC	Resistor, Fixed, Film 1.5K ±5% 1/4 Watt RL07AD152J	Q10, Base Bias
R19	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q1, Base Suppressor
R20	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q4, Base Suppressor
R21	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q5, Base Suppressor
R22	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q6, Base Coupling
R23	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q8, Base Coupling
R24	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q2, Base Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A2 R25	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q3, Base Bias
R26	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	CR7, Cathode Bias
R27	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	CR8, Cathode Bias
R28	IRC	Resistor, Fixed, Film 5.6K ±5% 1/4 Watt RL07AD562J	CR9, Cathode Bias
R29	IRC	Resistor, Fixed, Film 5.6K ±5% 1/4 Watt RL07AD562J	CR10, Cathode Bias
R30	IRC	Resistor, Fixed, Film 27K ±5% 1/4 Watt RL07AD273J	CR6, Cathode Bias
R31	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q6, Base Bias
R32	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q8, Base Bias
R33	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q10, Base Bias
R34	OHM	Resistor, Fixed, Composition 10Ω ±10% 1/4 Watt RC07GF100K	C13, Filtering
R35	OHM	Resistor, Fixed, Composition 10Ω ±10% 1/4 Watt RC07GF100K	C14, Filtering
R36	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q11, Collector
R37	TI	Resistor, Fixed, Film 10K ±1% 1/8 Watt RN60C1002F	C15, Timing
R38	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q12, Collector
R39	IRC	Resistor, Fixed, Film 2.2K ±5% 1/4 Watt RL07AD222J	Q14, Collector
R40	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD471J	Q15, Emitter
R41	IRC	Resistor, Fixed, Film 2.2K ±5% 1/4 Watt RL07AD222J	Q17, Collector

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A2			
R42	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD471J	Q18, Emitter
R43	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q11, Base Coupling
R44	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q13, Base Suppressor
R45	TI	Resistor, Fixed, Film 2.49K ±1% 1/8 Watt RN60C2491F	Q14, Tunnel Diode Series Resistor
R46	BRN	Resistor, Variable 1K Pot Bourns 3260H-1-102	Pickoff Adjust
R47	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q15, Base Suppressor
R48	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q16, Base Suppressor
R49	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q18, Base Suppressor
R50	TI	Resistor, Fixed, Film 3.01K ±1% 1/8 Watt RN60C3011F	Q17, Tunnel Diode Series Resistor
R51	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q11, Base Bias
R52	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	CR13, Cathode Bias
R53	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD471J	Q13, Emitter
R54	IRC	Resistor, Fixed, Film 680Ω ±5% 1/4 Watt RL07AD681J	R45, Impedance Matching
R55	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q14, Emitter Bias
R56	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD471J	Q16, Emitter
R57	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q17, Emitter Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A3		AUTOMATIC REPETITION RATE CONTROL CIRCUIT BOARD	D00400; Figs 5-13, -14, -15, -48
C1	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 100 µf ±10% 20V DCW CS13BE107K	R1, AGC Filter
C2	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) .1 µf ±10% 100V DCW CS13BH104K	Q2 Collector
C3	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) .01 µf ±10% 100V DCW CS13BJ103K	Q4 Base Coupling
C4	CD	Capacitor, Fixed, Mica Dielectric 180 pf ±5% 500V DCW CM06D181J03	Q4 Collector Coupling
C5	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	R29 Filtering +12.6V
C6	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	Filtering +12.6V
C7	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) .01 µf ±10% 100V DCW CS13BJ103K	Q1 Base Coupling
C8	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) .01 µf ±10% 100V DCW CS13BJ103K	Q3 Base Coupling
C9	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) .1 µf ±10% 75V DCW CS13BH104K	Q1 Coupling
C10	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) .1 µf ±10% 75V DCW CS13BH104K	Q2 Base Coupling
C11	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) .1 µf ±10% 75V DCW CS13BH104K	Q2 Emitter Bypass
C12	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) .1 µf ±10% 75V DCW CS13BH104K	Q3 Emitter Bypass
C13	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 1. µf ±10% 35V DCW CS13BF105K	Q4 Emitter Bypass
C14	CD	Capacitor, Fixed, Mica Dielectric 1000 pf ±5% 500V DCW CM06D102J03	Q5 Emitter Bypass
C15	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 1. µf ±10% 35V DCW CS13BF105K	Feedback Filtering
C16	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 1. µf ±10% 35V DCW CS13BF105K	R30 Filtering
C17	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q13 Base Speed Up
C18	CD	Capacitor, Fixed, Mica Dielectric 560 pf ±5% 500V DCW CM06D561J03	Q8 Collector Timing 4 µsec MV
C19	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q8 Base Speed Up

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A3			
C20	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	R32 Filtering +12.6V
C21	CD	Capacitor, Fixed, Mica Dielectric 56 pf ±5% 500V DCW CM05D560J03	CR9 Cathode, Coupling
C22	CD	Capacitor, Fixed, Mica Dielectric 56 pf ±5% 500V DCW CM05D560J03	CR10 Cathode, Coupling
C23	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 100 µf ±10% 20V DCW CS13BE107K	R44 Integrating
C24	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	CR11 Filtering
CR1	SOL	Diode White Noise Solitron SD2W12	C6 White Noise Generator
CR2	TI	Diode IN914	C9 Positive Clipper
CR3	TI	Diode IN914	C7 Positive Clipper
CR4	GE	Diode Tunnel IN3713	R16 Signal Pickoff
CR5	TI	Diode IN914	Q5 Emitter Standoff
CR6	TI	Diode IN914	R36 Temperature Compensating
CR7	TI	Diode IN914	Q7 Base Clamping
CR8	TI	Diode IN914	Q9 Base Temperature Compensating
CR9	TI	Diode IN914	Q7 Base Drive
CR10	TI	Diode IN914	Q7 Base Drive
CR11	MOT	Diode Zener 6.2V IN823	C23 Voltage Reference
CR12	TI	Diode IN914	R58, P/O OR Circuit
E1	USC	Terminal Stud USECO No. 2020B-1	Ground Terminal
E2	USC	Terminal Stud USECO No. 2020B-1	R32 +12.6V
E3	USC	Terminal Stud USECO No. 2020B-1	R30 -12.6V
E4	USC	Terminal Stud USECO No. 2020B-1	R13 Test Point
E5	USC	Terminal Stud USECO No. 2020B-1	R31 Test Point
E6	USC	Terminal Stud USECO No. 2020B-1	C22 Signal from Decoder
E7	USC	Terminal Stud USECO No. 2020B-1	Blanking Gate Input
E8	USC	Terminal Stud USECO No. 2020B-1	Ground Terminal

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A3			
Q1	TI	Transistor 2N706	Emitter Follower
Q2	TI	Transistor 2N706	Amplifier
Q3	TI	Transistor 2N706	Amplifier
Q4	TI	Transistor 2N706	Amplifier
Q5	TI	Transistor 2N706	Pick Off Circuitry
Q6	MOT	Transistor 2N869A	PNP Emitter Follower
Q7	TI	Transistor 2N706	4μsec Multivibrator
Q8	TI	Transistor 2N706	4μsec Multivibrator
Q9	TI	Transistor 2N1132	Amplifier
Q10	TI	Transistor 2N2060	Differential Amplifier
Q11	TI	Transistor 2N706	Emitter Follower Output
Q12	TI	Transistor 2N706	Inhibit Gate
Q13	MOT	Transistor 2N2219	Integrator
R1	IRC	Resistor, Fixed Film 2.2K ±5% 1/4 Watt RL07AD222J	C1, AGC Filtering
R2	IRC	Resistor, Fixed Film 100Ω ±5% 1/4 Watt RL07AD101J	+12.6V Filtering
R3	IRC	Determined by CR-1 Manufacturer	Current Limiting
R4	IRC	Resistor, Fixed Film 27K ±5% 1/4 Watt RL07AD273J	Q1 Base Bias
R5	IRC	Resistor, Fixed Film 3.9K ±5% 1/4 Watt RL07AD392J	CR2 Anode Bias
R6	IRC	Resistor, Fixed Film 27K ±5% 1/4 Watt RL07AD273J	Q2 Base Bias
R7	IRC	Resistor, Fixed Film 3.9K ±5% 1/4 Watt RL07AD392J	Q2 Collector
R8	IRC	Resistor, Fixed Film 3.3K ±5% 1/4 Watt RL07AD332J	CR3 Anode Bias
R9	IRC	Resistor, Fixed Film 27K ±5% 1/4 Watt RL07AD273J	Q3 Base Bias
R10	IRC	Resistor, Fixed Film 3.9K ±5% 1/4 Watt RL07AD392J	Q3 Collector
R11	IRC	Resistor, Fixed Film 27K ±5% 1/4 Watt RL07AD273J	Q4 Base Bias
R12	IRC	Resistor, Fixed Film 2.2K ±5% 1/4 Watt RL07AD222J	Q4 Collector

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A3			
R13	IRC	Resistor, Fixed Film 560Ω ±5% 1/4 Watt RL07AD561J	TP E4 Series Resistor
R14	IRC	Resistor, Fixed Film 2.2K ±5% 1/4 Watt RL07AD222J	Q5 Collector
R15	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	Q6 Emitter
R16	IRC	Resistor, Fixed Film 100Ω ±5% 1/4 Watt RL07AD101J	Q6 Base Suppressor
R17	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	CR4 Cathode Series Resistor
R18	IRC	Resistor, Fixed Film 560Ω ±5% 1/4 Watt RL07AD561J	Q1 Emitter, Clipper Series Resistor
R19	IRC	Resistor, Fixed Film 27K ±5% 1/4 Watt RL07AD273J	Q1 Base Bias
R20	IRC	Resistor, Fixed Film 2.7 ±5% 1/4 Watt RL07AD272J	Q1 Emitter
R21	IRC	Resistor, Fixed Film 3.9K ±5% 1/4 Watt RL07AD392J	Q2 Base Bias
R22	IRC	Resistor, Fixed Film 560Ω ±5% 1/4 Watt RL07AD561J	Q2 Emitter
R23	IRC	Resistor, Fixed Film 3.9K ±5% 1/4 Watt RL07AD392J	Q3 Base Bias
R24	IRC	Resistor, Fixed Film 3.9K ±5% 1/4 Watt RL07AD392J	Q3 Emitter
R25	IRC	Resistor, Fixed Film 3.3K ±5% 1/4 Watt RL07AD332J	Q4 Base Bias
R26	IRC	Resistor, Fixed Film 220Ω ±5% 1/4 Watt RL07AD221J	Q4 Emitter
R27	IRC	Resistor, Fixed Film 3.9K ±5% 1/4 Watt RL07AD392J	C4 DC Return for CR4
R28	IRC	Resistor, Fixed Film 10K ±5% 1/4 Watt RL07AD103J	Q5 Emitter Bias
R29	OHM	Resistor, Fixed Composition 10Ω ±10% 1/4 Watt RC07GF100K	Filtering +12.6V
R30	IRC	Resistor, Fixed Film 100Ω ±5% 1/4 Watt RL07AD101J	Filtering -12.6V
R31	IRC	Resistor, Fixed Film 3.9K ±5% 1/4 Watt RL07AD392J	TP E5 Series Resistor
R32	OHM	Resistor, Fixed Composition 10Ω ±10% 1/4 Watt RC07GF100K	Filtering +12.6V

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A3			
R33	IRC	Resistor, Fixed Film 10K ±5% 1/4 Watt RL07AD103J	C18, MV Timing 4μsec
R34	IRC	Resistor, Fixed Film 560Ω ±5% 1/4 Watt RL07AD561J	Q7 Collector
R35	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	Q8 Collector
R36	IRC	Resistor, Fixed Film 2.4K ±5% 1/4 Watt RL07AD242J	Q10 Collector
R37	IRC	Resistor, Fixed Film 2K ±5% 1/4 Watt RL07AD202J	Q10 Collector
R38	IRC	Resistor, Fixed Film 560Ω ±5% 1/4 Watt RL07AD561J	CR11 Current Limiting
R39	IRC	Resistor, Fixed Film 2.7K ±5% 1/4 Watt RL07AD272J	Q7 Collector Coupling
R40	IRC	Resistor, Fixed Film 2.4K ±5% 1/4 Watt RL07AD242J	Q7 Collector Coupling
R41	IRC	Resistor, Fixed Film 5.6K ±5% 1/4 Watt RL07AD562J	CR9 Cathode Bias
R42	IRC	Resistor, Fixed Film 470Ω ±5% 1/4 Watt RL07AD471J	Voltage Divider
R43	IRC	Resistor, Fixed Film 5.6K ±5% 1/4 Watt RL07AD562J	CR10 Cathode Bias
R44	IRC	Resistor, Fixed Film 120Ω ±5% 1/4 Watt RL07AD121J	Q13 Collector Integrating
R45	IRC	Resistor, Fixed Film 1.5K ±5% 1/4 Watt RL07AD152J	Q10 Base Series Resistor
R46	IRC	Resistor, Fixed Film 2.2K ±5% 1/4 Watt RL07AD222J	Q10 Base Series Resistor
R47	BRN	Resistor, Variable 500Ω POT Bourns No. 3260H-1-501	Q10 Base ARRC Adjust
R48	IRC	Resistor,Fixed Film 100Ω ±5% 1/4 Watt RL07AD101J	Q11 Base Suppressor
R49	IRC	Resistor, Fixed Film 1K ±5% 1/4 Watt RL07AD102J	Voltage Divider
R50	IRC	Resistor, Fixed Film 18K ±5% 1/4 Watt RL07AD183J	Q12 Base Bias
R51	IRC	Resistor, Fixed Film 2.7K ±5% 1/4 Watt RL07AD272J	Q12 Base Series Resistor
R52	IRC	Resistor, Fixed Film 18K ±5% 1/4 Watt RL07AD183J	Q8 Base Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A3			
R53	IRC	Resistor, Fixed Film 39K ±5% 1/4 Watt RL07AD393J	Q13 Base Bias
R54	IRC	Resistor, Fixed Film 4.7K ±5% 1/4 Watt RL07AD472J	Bias Resistor
R55	IRC	Resistor, Fixed Film 2K ±5% 1/4 Watt RL07AD202J	Q10 Emitter
R56	IRC	Resistor, Fixed Film 2.7K ±5% 1/4 Watt RL07AD272J	Voltage Divider
R57	IRC	Resistor, Fixed Film 470Ω ±5% 1/4 Watt RL07AD471J	Q11 Emitter
R58	IRC	Resistor, Fixed Film 8.2K ±5% 1/4 Watt RL07AD822J	CR12, P/O OR Circuit

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A3		CONTROL SECTION I (Outside of Dotted Line)	E00383; Figs 5-16 -17, -18, -49
C25	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BF156K	+12.6V Filtering
C26	CD	Capacitor, Fixed, Mica Dielectric 5 pf ±10% 500V DCW CM05C050K03	Q14, Collector Feedback
C27	CD	Capacitor, Fixed, Mica Dielectric 8,200 pf ±5% 500V DCW CM07E822J03	R65, Timing 47 µsec MV
C28	CD	Capacitor, Fixed, Mica Dielectric 560 pf ±5% 500V DCW CM06D561J03	R68, Timing 4 µsec MV
C29	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q17, Base Speed Up
C30	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q19, Base Speed Up
C31	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 1 µf ±10% 35V DCW CS13BF016K	Q14, Base Coupling
C32	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	CR16, Cathode Coupling
C33	CD	Capacitor, Fixed, Mica Dielectric 56 pf ±5% 500V DCW CM05D560J03	CR17, Cathode Coupling
C34	CD	Capacitor, Fixed, Mica Dielectric 18,000 pf ±5% 500V DCW CM07E183J03	R85, Timing Echo Suppressor MV
C35	CD	Capacitor, Fixed, Mica Dielectric 8,200 pf ±5% 500V DCW CM07E822J03	R85, Timing Echo Suppressor MV
C36	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q24, Base Speed Up
C37	CD	Capacitor, Fixed, Mica Dielectric 180 pf ±5% 500V DCW CM05D181J03	CR26, Cathode Coupling
C38	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20 V DCW CS13BE1 K	+12.6V Filtering

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A3			
CR13	TI	Diode IN914	Emitter Q21 OR GATE 1
CR14	TI	Diode IN914	Q18, Base Clamping
CR15	TI	Diode IN914	Q20, Base Clamping
CR16	TI	Diode IN914	Q18, Base Drive
CR17	TI	Diode IN914	Q20, Base Drive
CR18	TI	Diode IN914	R79, OR GATE 1
CR19	TI	Diode IN914	R79, OR GATE 1
CR20	TI	Diode IN914	Q16, Emitter Bias
CR21	TI	Diode IN914	Q23, Base OR GATE 5
CR22	TI	Diode IN914	R88, OR GATE 4
CR23	TI	Diode IN914	R88, OR GATE 4
CR24	TI	Diode IN914	Q23, Base OR GATE 5
CR25	TI	Diode IN914	Q25, Base Clamping
CR26	TI	Diode IN914	Q25, Base Drive
E1	USC	Terminal Stud. USECO #2020B-1	Ground
E2	USC	Terminal Stud. USECO #2020B-1	+12.6 Volts
E9	USC	Terminal Stud. USECO #2020B-1	-12.6 Volts Filtered
E10	USC	Terminal Stud. USECO #2020B-1	+12.6 Volts Filtered
E11	USC	Terminal Stud. USECO #2020B-1	Q22, Emitter Signal going to delay line
E12	USC	Terminal Stud. USECO #2020B-1	Q18, Collector 47 μsec MV Output
E13	USC	Terminal Stud. USECO #2020B-1	CR18, Anode Input to OR GATE 1

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A3			
E14	USC	Terminal Stud. USECO #2020B-1	CR23, Input OR GATE 4
E15	USC	Terminal Stud. USECO #2020B-1	Q16, Pulser Plate Amplifier Output
E16	USC	Terminal Stud. USECO #2020B-1	R71, Pulser Plate Input from Antenna
E17	USC	Terminal Stud. USECO #2020B-1	CR22, Output OR GATE 4 to ASC Board
E18	USC	Terminal Stud. USECO #2020B-1	Q14, Emitter Ground for Pulser Plate Input Lead.
Q14	TI	Transistor 2N706	Pulser Plate Amplifier
Q15	TI	Transistor 2N706	Pulser Plate Darlington Amp.
Q16	TI	Transistor 2N706	Pulser Plate Darlington Amp.
Q17	TI	Transistor 2N706	47μ sec MVB
Q18	TI	Transistor 2N706	47μ sec MVB
Q19	TI	Transistor 2N706	4μ sec MVB
Q20	TI	Transistor 2N706	4μ sec MVB
Q21	TI	Transistor 2N706	Emitter Follower
Q22	TI	Transistor 2N706	Emitter Follower
Q23	TI	Transistor 2N706	Emitter Follower
Q24	TI	Transistor 2N706	20-65μ sec MVB
Q25	TI	Transistor 2N706	20-65μ sec MVB
R59	OHM	Resistor, Fixed, Composition 10Ω ±10% 1/4 Watt RC07GF100K	+12.6V Filter Network

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A3			
R60	IRC	Resistor, Fixed, Film 4.7K ±5% 1/4 Watt RL07AD472J	R71, Photo Transistor Bias
R61	IRC	Resistor, Fixed, Film 68K ±5% 1/4 Watt RL07AD683J	Q14, Base Bias
R62	IRC	Resistor, Fixed, Film 5.6K ±5% 1/4 Watt RL07AD562J	Q14, Collector
R63	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q16, Collector
R64	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q17, Collector
R65	TI	Resistor, Fixed, Film 8.25K ±1% 1/8 Watt RN60C8251F	C27, Timing 47 μsec MV
R66	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q18, Collector
R67	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q19, Collector
R68	TI	Resistor, Fixed, Film 10K ±1% 1/8 Watt RN60C1002F	C28, Timing 4 μsec MV
R69	IRC	Resistor, Fixed, Film 620Ω ±5% 1/4 Watt RL07AD621J	Q20, Collector
R70	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q21, Base Suppressor
R71	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD0471J	R60, Input Matching
R72	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q17, Base Coupling
R73	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	CR16, Cathode Bias
R74	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q19, Base Coupling
R75	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q22, Base Suppressor
R76	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q17, Base Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A3			
R77	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q19, Base Bias
R78	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	CR17, Cathode Bias
R79	IRC	Resistor, Fixed, Film 27K ±5% 1/4 Watt RL07AD273J	CR19, Cathode Bias
R80	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD471J	Q22, Emitter
R81	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD471J	Q21, Emitter
R82	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD471J	Q24, Collector
R83	BRN	Resistor, Variable 10K Pot Bourns #3260H-1-103	C35, Timing 20-65 μsec MV
R84	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q25, Collector
R85	TI	Resistor, Fixed, Film 2.49K ±1% 1/8 Watt RN60C2491F	C35, Timing 20-65 μsec MV
R86	IRC	Resistor, Fixed, Film 2.2K 1/4 Watt RL07AD222J	Q24, Base Coupling
R87	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	CR26, Cathode Bias
R88	IRC	Resistor, Fixed, Film 27K ±5% 1/4 Watt RL07AD273J	CR23, Cathode Bias
R89	IRC	Resistor, Fixed, Film 27K ±5% 1/4 Watt RL07AD273J	Q23, Base Bias
R90	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD0471J	Q23, Emitter
R91	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q24, Base Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A4		CONTROL SECTION II (Inside Dotted Line)	E00383; Figs 5-19, -20, -21, -49
C1	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	R1, Filter Network +12.6
C2	CD	Capacitor, Fixed, Mica Dielectric 1000 pf ±5% 500V DCW CM06D102J03	Q2, Emitter Bypass
C3	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	R11, Filter Network +12.6
C4	CD	Capacitor, Fixed, Mica Dielectric 1000 pf ±5% 500V DCW CM06D102J03	Q5, Emitter Bypass
C5	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	R5, Filter Network +12.6
C6	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	R19, Filter Network -12.6
C7	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 6.8 µf ±10% 35V DCW CS13BF685K	R20, Filter Network +25.2
C8	CD	Capacitor, Fixed, Mica Dielectric 18,000 pf ±5% 500V DCW CM07F183J03	Q7, Collector Timing 394 µsec MV
C9	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q9, Base Speed Up
C10	CD	Capacitor, Fixed, Mica Dielectric 560 pf ±5% 500V DCW CM06D561J03	Q12, Collector Timing 4 µsec MV
C11	CD	Capacitor, Fixed, Mica Dielectric 470 pf ±5% 500V DCW CM06D471J03	Q14, Collector Timing 1-4 µsec MV
C12	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q7, Base Speed Up
C13	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q12, Base Speed Up
C14	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q14, Base Speed Up
C15	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q16, Base Speed Up
C16	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	CR14, Cathode, Coupling

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A4			
C17	CD	Capacitor, Fixed, Mica Dielectric 560 pf ±5% 500V DCW CM06D561J03	CR12 Cathode, Coupling
C18	CD	Capacitor, Fixed, Mica Dielectric 56 pf ±5% 500V DCW CM05D560J03	CR13 Cathode, Coupling
CR1	GE	Diode, Tunnel IN3713	Q2, Base
CR2	TI	Diode IN914	Q2, Emitter Standoff
CR3	GE	Diode, Tunnel IN3713	Q5, Base
CR4	TI	Diode IN914	Q5, Emitter Standoff
CR5	TI	Diode IN914	R26 AND GATE 3
CR6	TI	Diode IN914	R26 AND GATE 3
CR7	TI	Diode IN914	CR8, R34 AND GATE 2
CR8	TI	Diode IN914	R34 AND GATE 2
CR9	TI	Diode IN914	Q8, Base Clamping
CR10	TI	Diode IN914	Q11, Base Clamping
CR11	TI	Diode IN914	Q13, Base Clamping
CR12	TI	Diode IN914	Q8, Base Drive
CR13	TI	Diode IN914	Q11, Base Drive
CR14	TI	Diode IN914	Q13, Base Drive
E1	USC	Terminal Stud. USECO #2020B-1	Ground
E2	USC	Terminal Stud. USECO #2020B-1	R1, +12.6 volts

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A4			
E3	USC	Terminal Stud. USECO #2020B-1	R19, -12.6 volts
E4	USC	Terminal Stud. USECO #2020B-1	R20, +25.2 volts
E5	USC	Terminal Stud. USECO #2020B-1	Q3, Output to Modulator
E6	USC	Terminal Stud. USECO #2020B-1	DL1, Signal Input
E7	USC	Terminal Stud. USECO #2020B-1	-12.6V Filtered
E8	USC	Terminal Stud. USECO #2020B-1	+12.6V Filtered
E9	USC	Terminal Stud. USECO #2020B-1	C9, Input from 47 μsec MV
E10	USC	Terminal Stud. USECO #2020B-1	R47, Output AND Gate 3
E11	USC	Terminal Stud. USECO #2020B-1	Q8 Collector, Output 394 μsec MV
E12	USC	Terminal Stud. USECO #2020B-1	C17, Input to 394 μsec MV
DL1	ESC	Delay Line 27μ sec Tapped ESC Corporation # 54-30	Q1, Base
Q1	TI	Transistor, NPN, Silicon, 2N706	Emitter Follower
Q2	TI	Transistor, NPN, Silicon, 2N706	Main Signal Pickoff
Q3	MOT	Transistor, PNP, Silicon 2N869A	PNP Emitter Follower
Q4	TI	Transistor, NPN, Silicon, 2N706	Emitter Follower
Q5	TI	Transistor, NPN, Silicon, 2N706	North Burst Pickoff
Q6	MOT	Transistor, PNP, Silicon 2N869A	PNP, Emitter Follower
Q7	MOT	Transistor, NPN, Silicon 2N2219	North Burst Gating Multivibrator 394 μsec

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A4 Q8	MOT	Transistor, NPN, Silicon 2N2219	North Burst Gating Multivibrator 394 μsec
Q9	TI	Transistor, NPN, Silicon 2N706	Inverter
Q10	TI	Transistor, NPN, Silicon 2N706	Emitter Follower
Q11	TI	Transistor, NPN, Silicon 2N706	4μ sec MV
Q12	TI	Transistor, NPN, Silicon 2N706	4μ sec MV
Q13	TI	Transistor, NPN, Silicon 2N706	Pulse Spacing Multivibrator 1-4 μsec
Q14	TI	Transistor, NPN, Silicon 2N706	Pulse Spacing Multivibrator 1-4 μsec
Q15	TI	Transistor, NPN, Silicon 2N706	Emitter Follower
Q16	MOT	Transistor, NPN, Silicon 2N2219	Inverter
R1	OHM	Resistor, Fixed, Composition 10Ω ±10% 1/4 Watt RC07GF100K	C1, Filter Network +12.6V
R2	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q1, Base Suppressor
R3	IRC	Resistor, Fixed, Film 2.2K ±5% 1/4 Watt RL07AD222J	Q2, Collector
R4	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q3, Emitter
R5	OHM	Resistor, Fixed, Composition 10Ω ±10% 1/4 Watt RC07GF100K	C5, Filter Network +12.6V
R6	TI	Resistor, Fixed, Film 2.49K ±1% 1/8 Watt RN60C2491F	CR1 Anode Tunnel Diode Series Resistor
R7	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q3, Base Suppressor
R8	IRC	Resistor, Fixed, Film 510Ω ±5% 1/4 Watt RL07AD511J	Delay Line (DL1) Terminating

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A4 R9	IRC	Resistor, Fixed, Film 470Ω 1/4 Watt RL07AD471J	Q1, Emitter
R10	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q2, Emitter Bias
R11	TI	Resistor, Fixed, Composition 10Ω ±10% 1/4 Watt RC07GF100K	C3, Filter Network +12.6V
R12	IRC	Resistor, Fixed, Film 2.2K ±5% 1/4 Watt RL07AD222J	Q5, Collector
R13	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q6, Emitter
R14	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q4, Base Suppressor
R15	TI	Resistor, Fixed, Film 2.49K ±1% 1/8 Watt RN60C2491F	CR3 Anode Tunnel Diode Series Resistor
R16	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q6, Base Suppressor
R17	IRC	Resistor, Fixed, Film 470Ω 1/4 Watt RL07AD471J	Q4, Emitter
R18	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q5, Emitter Bias
R19	TI	Resistor, Fixed, Composition 10Ω ±10% 1/4 Watt RC07GF100K	C6, Filter Network -12.6V
R20	TI	Resistor, Fixed, Composition 10Ω ±10% 1/4 Watt RC07GF100K	C7, Filter Network +25.2V
R21	IRC	Resistor, Fixed, Film 2.2K ±5% 1/4 Watt RL07AD222J	Q7, Collector
R22	BRN	Resistor, Variable 10K Pot Bourns 3260H-1-103	394μ sec MVB Timing
R23	TI	Resistor, Fixed, Film 24.9K ±1% 1/8 Watt RN60C2492F	394μ sec MVB Timing
R24	IRC	Resistor, Fixed, Film 2.2K ±5% 1 Watt RL32AD222J	Q8, Collector
R25	IRC	Resistor, Fixed, Film 560Ω ±5% 1/4 Watt RL07AD561J	Q9, Collector

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A4			
R26	IRC	Resistor, Fixed, Film 4.7K ±5% 1/4 Watt RL07AD472J	CR5, CR6 AND GATE 3
R27	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q11, Collector
R28	TI	Resistor, Fixed, Film 10K ±1% 1/8 Watt RN60C1002F	4μ sec MVB Timing
R29	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q12, Collector
R30	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q13, Collector
R31	BRN	Resistor, Variable 10K Pot Bourns 3260H-1-103	1-4μ sec MVB Timing
R32	TI	Resistor, Fixed, Film 2.49K ±1% 1/8 Watt RN60C2491F	1-4μ sec MVB Timing
R33	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q14, Collector
R34	IRC	Resistor, Fixed, Film 270Ω ±5% 1/4 Watt RL07AD271J	Q16, Collector
R35	IRC	Resistor, Fixed, Film 5.6K ±5% 1/4 Watt RL07AD562J	Q7, Base Coupling
R36	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q9, Base Coupling
R37	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q10, Base Suppressor
R38	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q12, Base Coupling
R39	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	CR14, Cathode Bias
R40	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q14, Base Coupling
R41	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q15, Base Suppressor
R42	IRC	Resistor, Fixed, Film 2.2K ±5% 1/4 Watt RL07AD222J	Q16, Base Coupling

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A4			
R43	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	CR13, Cathode Bias
R44	IRC	Resistor, Fixed, Film 27K ±5% 1/4 Watt RL07AD273J	Q7, Base Bias
R45	IRC	Resistor, Fixed, Film 5.6K ±5% 1/4 Watt RL07AD562J	CR12, Cathode Bias
R46	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q9, Base Bias
R47	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q10, Emitter
R48	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q12, Base Bias
R49	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q14, Base Bias
R50	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q15, Emitter
R51	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	CR7, CR8, Bias AND GATE 2
R52	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q16, Base Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A5		ENCODER AND MODULATOR SECTION	E00402; Figs 5-22, -23, -24, -50
C1	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20 VDC W CS13BE156K	L1, Filter +12.6V
C2	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 6.8 µf ±10% 35 VDC W CS13BF685K	R6, Filter +25.2V
C3	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20 VDC W CS13BE156K	Q9, Base Coupling
C4	CD	Capacitor, Fixed, Mica Dielectric 470 pf ±5% 500 VDC W CM06D471J03	Q1, Collector, Timing 1-4 µsec MV
C5	CD	Capacitor, Fixed, Mica Dielectric 620 pf ±5% 500 VDC W CM06D621J03	Q3, Collector Timing 12.0 µsec MV
C6	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500 VDC W CM05D121J03	Q4, Collector Coupling
C7	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 100 µf ±10% 20 VDC W CS13BE107K	Q7, Base Coupling
C8	CD	Capacitor, Fixed, Mica Dielectric 620 pf ±5% 500 VDC W CM06D21J03	Q5, Base Coupling
C9	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500 VDC W CM05D121J03	Q1, Base Speed Up
C10	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500 VDC W CM05D121J03	Q3, Base Speed Up
C11	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500 VDC W CM05D121J03	CR4, Cathode Coupling
C12	CD	Capacitor, Fixed, Mica Dielectric 390 pf ±5% 500 VDC W CM05D391J03	CR5, Cathode Coupling
C13	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500 VDC W CM05D121J03	CR6, Cathode Coupling
C14	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 100 µf ±10% 20 VDC W CS13BE107K	Q10, Emitter Uni-junction Timing ≈ 10 sec
C15	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 100 µf ±10% 20 VDC W CS13BE107K	Filtering -12.6V

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A5			
C16	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 6.8 µf ±10% 35 VDC W CS13BF685K	L3, Filter +25.2V
C17	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 6.8 µf ±10% 35 VDC W CS13BF685K	Q15, Filter +25.2V
C18	CD	Capacitor, Fixed, Mica Dielectric 180 pf ±5% 500 VDC W CM05D181J03	Q11, Collector MVB Timing 3.4µsec
C19	ERIE	Capacitor, Fixed, Ceramic Dielectric 4700 pf ±20% 500 VDC W CK62AW472M	CR11, Cathode Coupling
C20	CD	Capacitor, Fixed, Mica Dielectric 2000 pf ±5% 500 VDC W CM06E202G03	L4, Gaussian Filter
C21	CD	Capacitor, Fixed, Mica Dielectric 100 pf ±5% 500 VDC W CM05D101J03	L4, Gaussian Filter
C22	CD	Capacitor, Fixed, Mica Dielectric 820 pf ±5% 500 VDC W CM06D821J03	L5, Gaussian Filter
C23	CD	Capacitor, Fixed, Mica Dielectric 100 pf ±5% 500 VDC W CM05D101J03	L6, Gaussian Filter
C24	CD	Capacitor, Fixed, Mica Dielectric 200 pf ±5% 500 VDC W CM05D201J03	L6, Gaussian Filter
C25	CD	Capacitor, Fixed, Mica Dielectric 68 pf ±5% 500 VDC W CM05D680J03	R47, Speed up
C26	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ±10% 20 VDC W CS13BE156K	Q17, Filtering +12.6V
C27	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 6.8 µf ±10% 35 VDC W CS13BF685K	Q23, Filtering +25.2V
C28	CD	Capacitor, Fixed, Mica Dielectric 270 pf ±5% 500 VDC W CM05D271J03	Q16, Collector Timing 1 µsec MV
C29	CD	Capacitor, Fixed, Mica Dielectric 820 pf ±5% 500 VDC W CM06D821J03	Q18, Collector Timing 6 µsec MV
C30	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500 VDC W CM05D121J03	Q21, Base Speed Up
C31	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500 VDC W CM05D121J03	Q22, Base Speed Up
C32	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500 VDC W CM05D121J03	Q16, Base Speed Up

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A5			
C33	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500 VDC W CM05D121J03	Q18, Base Speed Up
C34	CD	Capacitor, Fixed, Mica Dielectric 220 pf ±5% 500 VDC W CM05D221J03	CR14, Cathode Coupling
C35	CD	Capacitor, Fixed, Mica Dielectric 120 pf ±5% 500 VDC W CM05D121J03	CR15, Cathode Coupling
CR1	TI	Diode IN914	CR6, OR GATE
CR2	TI	Diode IN914	Q2, Base Clamping
CR3	TI	Diode IN914	Q4, Base Clamping
CR4	TI	Diode IN914	Q2, Base Drive
CR5	TI	Diode IN914	Q4, Base Drive
CR6	TI	Diode IN914	CR1, OR GATE
CR7	TI	Diode IN914	Q6, Emitter Voltage Offset
CR8	GE	Silicon Controlled Rectifier 2N2322	Q10, Shunt
CR9	TI	Diode IN914	Q15, Emitter Temp.Compensating
CR10	TI	Diode IN914	Q12, Base Clamping
CR11	TI	Diode IN914	Q12, Base Drive
CR12	TI	Diode IN914	Q17, Base Clamping
CR13	TI	Diode IN914	Q19, Base Clamping
CR14	TI	Diode IN914	Q17, Base Drive
CR15	TI	Diode IN914	Q19, Base Drive

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION		LOCATING FUNCTION
1A2A1A1A5				
E1	USC	Terminal Stud.	USECO No. 2020B-1	Ground Terminal
E2	USC	Terminal Stud.	USECO No. 2020B-1	L1, +12.6 Volts
E3	USC	Terminal Stud.	USECO No. 2020B-1	L2, -12.6 Volts
E4	USC	Terminal Stud.	USECO No. 2020B-1	L3, +25.2 Volts
E5	USC	Terminal Stud.	USECO No. 2020B-1	C11, Input fm Control
E6	USC	Terminal Stud.	USECO No. 2020B-1	Q9 Emitter, Output to Tubes
E7	USC	Terminal Stud.	USECO No. 2020B-1	Q23 Emitter, Keying Gate Output
L1	CAM	Coil, Radio Frequency 22 µh	LT7K202	E2 +12.6V Filtering
L2	CAM	Coil, Radio Frequency 22 µh	LT7K202	E3 -12.6V Filtering
L3	CAM	Coil, Radio Frequency 22 µh	LT7K202	E4 +25.2V Filtering
L4	CAM	Coil, Radio Frequency 470 µh	LT4K064	C21, Gaussian Filter
L5	CAM	Coil, Radio Frequency 820 µh	LT4K067	C22, Gaussian Filter
L6	CAM	Coil, Radio Frequency 680 µh	LT4K066	C23, Gaussian Filter
Q1	TI	Transistor, 2N706		Overall Delay Multivibrator 1-4µsec
Q2	TI	Transistor, 2N706		Overall Delay Multivibrator 1-4µsec
Q3	MOT	Transistor, 2N2219		Pulse Spacing Multivibrator12.0µsec
Q4	MOT	Transistor, 2N2219		Pulse Spacing Multivibrator12.0µsec

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A5			
Q5	TI	Transistor, 2N706	Emitter Follower
Q6	TI	Transistor, 2N706	Time Delay Switch
Q7	MOT	Transistor, 2N2219	Amplifier
Q8	MOT	Transistor, 2N2905	Emitter Follower PNP
Q9	MOT	Transistor, 2N2905	Emitter Follower PNP
Q10	GE	Transistor, 2N494C	Delay Timing 10 sec
Q11	MOT	Transistor, 2N2219	Gaussian Width Multivibrator 3.4μsec
Q12	MOT	Transistor, 2N2219	Gaussian Width Multivibrator 3.4μsec
Q13	MOT	Transistor, 2N2219	Emitter Follower
Q14	MOT	Transistor, 2N2219	Emitter Follower
Q15	MOT	Transistor, 2N2905	Emitter Follower PNP
Q16	TI	Transistor, 2N706	Pedestal Delay Multivibrator 1 μsec
Q17	TI	Transistor, 2N706	Pedestal Delay Multivibrator 1 μsec
Q18	TI	Transistor, 2N706	Pedestal Width Multivibrator 6 μsec
Q19	TI	Transistor, 2N706	Pedestal Width Multivibrator 6 μsec
Q20	TI	Transistor, 2N706	Emitter Follower
Q21	MOT	Transistor, 2N2219	Gate Driver
Q22	MOT	Transistor, 2N2905	Gate Driver PNP
Q23	MOT	Transistor, 2N2219	Emitter Follower

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A5			
R1	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q1, Collector
R2	BRN	Resistor, Variable 10K pot Bourns 3260H-1-103	Q2, Delay Timing
R3	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q2, Collector
R4	IRC	Resistor, Fixed, Film 2.2K ±5% 1/4 Watt RL07AD222J	Q3, Collector
R5	BRN	Resistor, Variable 10K pot Bourns 3260H-1-103	Q4, Pulse Spacing
R6	IRC	Resistor, Fixed, Film 2.2K ±5% 1 Watt RL32AD222J	Q4, Collector
R7	IRC	Resistor, Fixed, Film 330K ±5% 1/2 Watt RL20AD334J	Q7, Base Bias
R8	IRC	Resistor, Fixed, Film 4.7K ±5% 1/4 Watt RL07AD472J	Q7, Collector
R9	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q10, Base 2
R10	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q8, Emitter
R11	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q9, Base Bias
R12	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q9, Emitter
R13	TI	Resistor, Fixed, Film 2.49K ±1% 1/8 Watt RN60C2491F	CR2, Anode Timing 1-4 μsec MV
R14	TI	Resistor, Fixed, Film 20.5K ±1% 1/8 Watt RN60C2052F	CR3, Anode Timing 1-4 μsec MV
R15	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q5, Base Bias
R16	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q1, Base Coupling
R17	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	CR4, Cathode Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A5 R18	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q3, Base Coupling
R19	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	CR1, Cathode
R20	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q7, Base Bias
R21	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q6, Base Series
R22	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD471J	Q7, Emitter
R23	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q1, Base Bias
R24	IRC	Resistor, Fixed, Film 27K ±5% 1/4 Watt RL07AD273J	Q3, Base Bias
R25	IRC	Resistor, Fixed, Film 3.9K ±5% 1/4 Watt RL07AD392J	CR5, Cathode
R26	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	CR1 & CR6, Anode Load
R27	IRC	Resistor, Fixed, Film 470Ω ±5% 1/2 Watt RL20AD471J	Q5, Emitter
R28	IRC	Resistor, Fixed, Film 68K ±5% 1/4 Watt RL07AD683J	Q10, Emitter Timing 10 sec
R29	IRC	Resistor, Fixed, Film 5.6K ±5% 1/4 Watt RL07AD562J	CR6, Cathode
R30	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	CR8, Gate Series
R31	IRC	Resistor, Fixed, Film 56Ω ±5% 1/4 Watt RL07AD560J	Q10, Base 1
R32	IRC	Resistor, Fixed, Film 2.2K ±5% 1/4 Watt RL07AD222J	Q11, Collector
R33	BRN	Resistor, Variable 10K Pot Bourns 3260H-1-103	Q12, Gaussian Width Timing
R34	IRC	Resistor, Fixed, Film 2.2K ±5% 1 Watt RL32AD222J	Q12, Collector

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A5			
R35	IRC	Resistor, Fixed, Film 2.2K ±5% 1 Watt RL32AD222J	CR9, Anode
R36	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q12, Gaussian Width Timing 3.4 μsec
R37	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q11, Base Coupling
R38	IRC	Resistor, Fixed, Film 330K ±5% 1/2 Watt RL20AD334J	Q12, Base Coupling
R39	IRC	Resistor, Fixed, Film 150Ω ±5% 1/4 Watt RL07AD151J	Q13, Emitter Gaussian Filter Matching
R40	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q14, Base Suppressor
R41	IRC	Resistor, Fixed, Film 3.3K ±5% 1/4 Watt RL07AD332J	R47, Summing Network
R42	IRC	Resistor, Fixed, Film 27K ±5% 1/4 Watt RL07AD273J	Q11, Base Bias
R43	IRC	Resistor, Fixed, Film 5.6K ±5% 1/4 Watt RL07AD562J	CR11, Cathode
R44	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q13, Emitter
R45	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q14, Gaussian Filter Load
R46	BRN	Resistor, Variable 1K Pot Bourns 3260H-1-102	Q14, Emitter Gaussian Amplitude Adjust
R47	IRC	Resistor, Fixed, Film 3.3K ±5% 1/4 Watt RL07AD332J	R41, Summing Network
R48	BRN	Resistor, Variable 10K Pot Bourns 3260H-1-103	Q15, Base Modulator Amplitude Adjust
R49	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q16, Collector
R50	BRN	Resistor, Variable 5K Pot Bourns 3260H-1-502	Q17, Pedestal Delay Timing 1 μsec
R51	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q17, Collector

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A5			
R52	IRC	Resistor, Fixed, Film 560Ω ±5% 1/4 Watt RL07AD561J	Q18, Collector
R53	BRN	Resistor, Variable 5K Pot Bourns 3260H-1-502	Q19, Pedestal Width Timing 6 μsec
R54	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q19, Collector
R55	IRC	Resistor, Fixed, Film 2.2K ±5% 1/4 Watt RL07AD222J	Q21, Collector
R56	TI	Resistor, Fixed, Film 2.49K ±1% 1/8 Watt RN60C2491F	Q12, Pedestal Delay Timing 1 μsec
R57	TI	Resistor, Fixed, Film 7.5K ±1% 1/8 Watt RN60C7501F	Q19, Pedestal Width Timing 6 μsec
R58	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q16, Base Coupling
R59	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	CR14, Cathode Bias
R60	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q18, Base Coupling
R61	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	CR15, Cathode Bias
R62	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	Q20, Base Suppressor
R63	IRC	Resistor, Fixed, Film 6.8K ±5% 1/4 Watt RL07AD682J	Q21, Base Coupling
R64	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	Q22, Base Coupling
R65	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD471J	Q23, Base Suppressor
R66	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q16, Base Bias
R67	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q18, Base Bias
R68	BRN	Resistor, Variable 500Ω Pot Bourns 3260H-1-501	Q20, Emitter Pedestal Amplitude Adjust

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A1A5			
R69	IRC	Resistor, Fixed, Film 27K ±5% 1/4 Watt RL07AD273J	Q21, Base Bias
R70	IRC	Resistor, Fixed, Film 2.2K ±5% 1/4 Watt RL07AD222J	Q22, Collector
R71	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD471J	Q23, Emitter
S3	JBT	Switch, 3 pos. 2 pole, 2 deck 60° SR05N60C3MGC JBTV72031N	Front Panel, Mode Switch

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A2		TRANSPONDER POWER SUPPLY	D00396, Figs 5-32, -33, -34, -56
C1	ERIE	Capacitor, Ceramic Dielectric 1500 pf ± 20% 500V DCW CK70AW152M	+12.6V Feedthru
C2	SPR	Capacitor, Solid Electrolyte (Tantalum) 1 µf ± 10% 35V DCW CS13BF105K	HY1 Filtering
C3	SPR	Capacitor, Solid Electrolyte (Tantalum) 100 µf ± 10% 20V DCW CS13BE107K	L1 Filtering
C4	SPR	Capacitor, Solid Electrolyte (Tantalum) 100 µf ± 10% 20V DCW CS13BE107K	L1 Filtering
C5	SPR	Capacitor, Solid Electrolyte (Tantalum) 1 µf ± 10% 35V DCW CS13BF105K	R1 Speed Up
C6	SPR	Capacitor, Solid Electrolyte (Tantalum) 100 µf ± 10% 20V DCW CS13BE107K	L2 Filtering
C7	SPR	Capacitor, Solid Electrolyte (Tantalum) 100 µf ± 10% 20V DCW CS13BE107K	L2 Filtering
C8	ERIE	Capacitor, Ceramic Dielectric 1500 pf ± 20% 500V DCW CK70AW152M	-12.6V Feedthru
C9	SPR	Capacitor, Solid Electrolyte (Tantalum) 1 µf ± 10% 35V DCW CS13BF105K	HY2 Filtering
C10	ERIE	Capacitor, Ceramic Dielectric 1500 pf ± 20% 500V DCW CK70AW152M	+ 25.2V Feedthru
C11	SPR	Capacitor, Solid Electrolyte (Tantalum) 1 µf ± 10% 35V DCW CS13BF105K	HY3 Filtering
C12	SPR	Capacitor, Solid Electrolyte (Tantalum) 47 µf ± 10% 35V DCW CS13BF476K	L3 Filtering
C13	SPR	Capacitor, Solid Electrolyte (Tantalum) 47 µf ± 10% 35V DCW CS13BF476K	L3 Filtering
C14	ERIE	Capacitor, Ceramic Dielectric 1500 pf ± 20% 500V DCW CK70AW152M	+6.3V Feedthru
C15	SPR	Capacitor, Solid Electrolyte (Tantalum) 22 µf ± 10% 35V DCW CS13BF226K	Q4 Starting Bias
C16	SPR	Capacitor, Solid Electrolyte (Tantalum) 15 µf ± 10% 20V DCW CS13BE156K	+6.3V Filtering

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A2			
C17	SPR	Capacitor, Solid Electrolyte (Tantalum) 47 µf ± 10% 35V DCW CS13BF476K	R8 Filtering
C18	SPR	Capacitor, Solid Electrolyte (Tantalum) 47 µf ± 10% 35V DCW CS13BF476K	Q2 Q7 Filtering
C19	SPR	Capacitor, Solid Electrolyte (Tantalum) 1 µf ± 10% 35V DCW CS13BF105K	R13 Speed Up
C20	PCI	Capacitor 0.1µf ± 10% 2000V DCW Plastic Capacitors, Inc. #0F20-104	CR11 Voltage Doubler
C21	GE	Capacitor, Paper Dielectric 2 µf ± 10% 1500V DCW CP70B1EH205K1	CR11 Voltage Doubler
C22	ERIE	Capacitor, Ceramic Dielectric 1500 pf ± 20% 500V DCW CK70AW152M	E11 Feed Thru
C23	ERIE	Capacitor, Ceramic Dielectric 1500 pf ± 20% 500V DCW CK70AW152M	E12 Feed Thru
C24	ERIE	Capacitor, Ceramic Dielectric 1500 pf ± 20% 500V DCW CK70AW152M	E13 Feed Thru
CR1	UNI	Diode Unitrode Corp. #UTX 205	+ 12.6V Rectifier
CR2	UNI	Diode Unitrode Corp. #UTX 205	+ 12.6V Rectifier
CR3	UNI	Diode Unitrode Corp. #UTX 205	- 12.6V Rectifier
CR4	UNI	Diode Unitrode Corp. #UTX 205	-12.6V Rectifier
CR5	UNI	Diode Unitrode Corp. #UTX 210	+ 25.2V Rectifier
CR6	UNI	Diode Unitrode Corp. #UTX 210	+ 25.2V Rectifier
CR7	UNI	Diode Unitrode Corp. #UTX 205	+ 6.3V Rectifier
CR8	MOT	Diode, Zener Reference IN943B	Q5 Base Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION		LOCATING FUNCTION
1A2A1A2				
CR9	UNI UNI	Diode Unitrode Corp. #UTX 205		+ 6.3V Rectifier
CR10	UNI	Diode Unitrode Corp. #USR 15		+ 1000V Rectifier
CR11	UNI	Diode Unitrode Corp. #USR 15		+ 1000V Rectifier
CR12	TI	Diode IN1614 (Back of Front Panel)		J4 Polarity Protection
CR13	TI	Diode IN1614 (Back of Front Panel)		J4 Polarity Protection
DS1	CM	Lamp 28V MS25237-327 (Back of Front Panel)		S4 Indicator
HY1	FCA	A #22 Wire Going Thru 3 Ferrox Cube Beads K5-001-00/3B		C2 Filtering
HY2	FCA	A #22 Wire Going Thru 3 Ferrox Cube Beads K5-001-00/3B		C9 Filtering
HY3	FCA	A #22 Wire Going Thru 3 Ferrox Cube Beads K5-001-00/3B		C11 Filtering
HY4	FCA	A #22 Wire Going Thru 3 Ferrox Cube Beads K5-001-00/3B		C14 Filtering
J3	BDX	Connector	Bendix MS3114E10-6S	Power Output
J4	BDX	Connector	Bendix MS3114E10-6P	Power Input
L1	CAM	Inductor 10 μh	LT4K046	C3 Filtering
L2	CAM	Inductor 10 μh	LT4K046	C6 Filtering

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION		LOCATING FUNCTION
1A2A1A2				
L3	CAM	Inductor 10 μh	LT4K046	C12 Filtering
L4	CAM	Inductor 1 μh	LT4K034	Q2 Base Suppressor
L5	CAM	Inductor 1 μh	LT4K034	Q7 Base Suppressor
Q1	MOT	Transistor	2N3790	Series Regulator
Q2	RCA	Transistor	2N3879	Power Output
Q3	MOT	Transistor	2N2905	Q1 Driver
Q4	MOT	Transistor	2N1132	Q2 Starter
Q5	TI	Transistor	2N697	R10 Differential Amplifier
Q6	TI	Transistor	2N697	R10 Differential Amplifier
Q7	RCA	Transistor	2N3879	Power Output
R1	OHM	Resistor, Fixed Composition 10 Ω ± 5% 1 watt	RC32GF100J	Q2 Base Series
R2	IRC	Resistor, Fixed Film 1K ± 5% 1/4 watt	RL07AD102J	Q1 Base Bias
R3	IRC	Resistor, Fixed Film 3.9K ± 5% 1/2 watt	RL20AD392J	Q5 Base Bias
R4	IRC	Resistor, Fixed Film 3.9K ± 5% 1/2 watt	RL20AD392J	Q6 Base Bias
R5	IRC	Resistor, Fixed Film 3.9K ± 5% 1/2 watt	RL20AD392J	Q4 Base Bias
R6	IRC	Resistor, Fixed Film 2.2K ± 5% 1/4 watt	RL07AD222J	Q3 Base Bias
R7	IRC	Resistor, Fixed Film 56 Ω ± 5% 1/4 watt	RL07AD560J	Q4 Collector

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A2			
R8	IRC	Resistor, Fixed Film 10K ± 5% 1/4 watt RL07AD103J	CR8 Bias
R9	MIN	Resistor, Variable 1K 1/4 watt Minelco #MF2S 1K	Q6 Base Bias
R10	IRC	Resistor, Fixed Film 2.7K ± 5% 1/4 watt RL07AD272J	Q5, Q6 Emitter Bias
R11	IRC	Resistor Fixed Film 5.6K ± 5% 1/4 watt RL07AD562J	Q6 Base Bias
R12	IRC	Resistor, Fixed Film 150 Ω ± 5% 1/4 watt RL07AD151J	Q4 Starting Bias
R13	OHM	Resistor, Fixed, Composition 10 Ω ± 5% 1 watt RC32GF100J	Q7 Base Series
R14	OHM	Resistor, Fixed, Composition 1.5 M ± 5% 1 watt RC32GF155J	+ 1000V Meter Circuit
R15	OHM	Resistor, Fixed, Composition 1.5 M ± 5% 1 watt RC32GF155J	+ 1000V Meter Circuit
R16	IRC	Resistor, Fixed Film 470 Ω ± 5% 1/4 watt RL07AD471J	+ 1000V Meter Circuit
S1	HET	Switch Hetherington #T2106 (On Back of Front Panel)	Transponder On - Off
S2	HET	Switch Hetherington #T2106 (On Back of Front Panel)	Antenna On - Off
S3	MS	Switch MS16106-1 (On Power Supply Chassis)	E11 Interlock
S4	MS	Switch MS16106-1 (On Power Supply Chassis)	DS1 Interlock
T1	MTK	Transformer Montek DWG D002700	Power Transformer
XDS1	LF	Lamp Holder Red Indicating Montek DWG C001046-1 (On Back of Front Panel)	S4 Indicator

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A3		TRANSMITTER & L.O. MULT. CHAIN	E00415; Figs 5-25 thru 5-31, 5-52
C1	ERIE	Capacitor, Fixed, Mica Dielectric 500 pf ± 10% 500V DCW CB60RD501K	L3 Filtering
C2	ERIE	Capacitor, Fixed, Mica Dielectric 500 pf ± 10% 500V DCW CB60RD501K	L4 Filtering
C3	ERIE	Capacitor, Fixed, Mica Dielectric 500 pf ± 10% 500V DCW CB60RD501K	L1 Filtering
C4	SPR	Capacitor, Fixed, (Tantalum) 47 µf ± 10% 20V DCW CS13BE476K	L6 Filtering
C5	SPR	Capacitor, Fixed, (Tantalum) .1 µf ± 10% 20V DCW CS13BE015K	L3 Filtering
C6	CD	Capacitor, Fixed, Mica Dielectric 22 pf ± 10% 500V DCW CM05D220J03	L10 Tuning
C7	ERIE	Capacitor, Variable: Ceramic 5.5--18 pf 200V DCW Erie 538-016 92R	L10 Tuning
C8	JHN	Capacitor, Variable 1--14 pf 250V DCW Johanson #3901	L11 Tuning
C9	CD	Capacitor, Fixed, Mica Dielectric 33 pf ± 5% 500V DCW CM05D330J03	L12 Coupling
C10	ERIE	Capacitor, Variable, Ceramic 5.5--18 pf 200V DCW Erie 538-016	T1, L14 Tuning
C11	JHN	Capacitor, Variable 1--14 pf 250V DCW Johanson #3901	L13 Tuning
C12	ERIE	Capacitor, Variable 5.5--18 pf 200V DCW Erie # 538-016 92R	Collector Q2 Tuning
C13	ERIE	Capacitor, Variable 5.5--18 pf 200V DCW Erie #538-016 92R	Collector Q3 Tuning
C14	JHN	Capacitor, Variable 1--30 pf 250V DCW Johanson #3908	Collector Q4 Tuning
C15	CD	Capacitor, Fixed Mica Dielectric 22 pf ± 5% 500V DCW CM05D220J03	T1, L14 Tuning
C16	CD	Capacitor, Fixed, Mica Dielectric 39 pf ± 5% 500V DCW CM05D391J03	T2, L15 Tuning
C17	CD	Capacitor, Fixed, Mica Dielectric 68 pf ± 5% 500V DCW CM05D680J03	Q1 Base Coupling

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES		LOCATING FUNCTION
1A2A1A3			
C18	CD	Capacitor, Fixed, Mica Dielectric 22 pf ± 5% 500V DCW CM05D220J03	CR 6 Cathode, Coupling
C19	ERIE	Capacitor, Variable 5.5--18 pf 200V DCW Erie #538-016 92B	L18 Tuning
C20	ERIE	Capacitor, Variable 5.5--18 pf 200V DCW Erie #538-016 92B	L9 Tuning
C21	ERIE	Capacitor, Variable Erie #538-016 92B 5.5--18 pf 200V DCW	L16 Tuning
C22	CD	Capacitor, Fixed, Mica Dielectric 10 pf ± 10% 500V DCW CM05D100J03	Q2 Base Coupling
C23	CD	Capacitor, Fixed, Mica Dielectric 22 pf ± 5% 500V DCW CM05D220J03	T1, L19 Tuning
C24	CD	Capacitor, Fixed, Mica Dielectric 39 pf ± 5% 500V DCW CM05D390J03	T2, L20 Tuning
C25	ERIE	Capacitor, Variable Erie #538-016 92B 5.5--18 pf 200V DCW	T1, L19 Tuning
C26	ERIE	Capacitor, Fixed Ceramic Dielectric 220 pf ± 10% 500V DCW CK61CZ221K	TP1 Filtering
C27	ERIE	Capacitor, Fixed Ceramic Dielectric 220 pf ± 10% 500V DCW CK61CZ221K	TP1 Filtering
C28	ERIE	Capacitor, Fixed Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	Emitter Q2 Bypass
C29	ERIE	Capacitor, Fixed Ceramic Dielectric 470 pf ± 10% 500V DCW CR61CZ471K	Emitter Q3 Bypass
C30	ERIE	Capacitor, Fixed Ceramic Dielectric 220 pf ± 10% 500V DCW CK61CZ221K	TP2 Filtering
C31	ERIE	Capacitor, Fixed, Mica Dielectric 500 pf ± 10% 500V DCW CB60RD501K	FL3, Filtering
C32	JHN	Capacitor, Variable 1--14 pf 250V DCW Johanson #3901	Q5 Collector, Tuning
C33	CD	Capacitor, Fixed, Mica Dielectric 5 pf ± 10% 500V DCW CM05C050K03	CR7 Cathode, Coupling
C34	ERIE	Capacitor, Fixed Ceramic Dielectric 20 pf ±2% 500V DCW CC20CH200G	L23 Filtering
C35	JHN	Capacitor, Variable 1--14 pf 250V DCW Johanson #3901	L23 Tuning

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A3 C36	ERIE	Capacitor, Fixed, Ceramic Dielectric 220 pf ± 10% 500V DCW CK61CZ221K	TP3 Filtering
C37	ERIE	Capacitor, Fixed, Mica Dielectric 500 pf ± 5% 500V DCW CB60RD501K	R32 Filtering
C38	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	L25 Filtering
C39	JHN	Capacitor, Variable Johanson #3901 1--14 pf 250V DCW	Q6 Collector Coupling
C40	CD	Capacitor, Fixed, Mica Dielectric 10 pf ± 10% 500V DCW CM05C100K03	Q6 Collector Coupling
C41	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	Q6 Base Coupling
C42	CD	Capacitor Fixed, Mica Dielectric 18 pf ± 10% 500V DCW CM05C180K03	L26 Filtering
C43	JHN	Capacitor, Variable Dielectric 1--14 pf 250V DCW Johanson #3901	L26 Tuning
C44	CD	Capacitor, Fixed, Mica Dielectric 10 pf ± 10% 500V DCW CM05C100K03	C43 Tuning
CR1	T1	Diode IN914	C10 Freq. Doubler
CR2	T1	Diode IN914	C16 Freq. Doubler
CR3	T1	Diode IN914	TP1 Rectifier
CR4	T1	Diode IN914	C24 Freq. Doubler
CR5	T1	Diode IN914	C25 Freq. Doubler
CR6	T1	Diode IN914	TP2 Rectifier
CR7	T1	Diode IN914	TP3 Rectifier
CR8	HPA	Diode HPA 0241	R31 Frequency Multiplier
CR9	HPA	Diode HPA 0241	R36 Frequency Multiplier

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A3 FL1	ERIE	Feedthru filter Erie part #1201-052	12.6V Filtering
FL2	ERIE	Feedthru filter Erie part #1201-052	12.6V Filtering
FL3	ERIE	Feedthru filter Erie part #1201-052	25V Filtering
L1		N O T U S E D	
L2	CAM	Inductor 10 µh LT4K046	FL1 Filtering
L3	CAM	Inductor .47 µh LT4K030	C1 Filtering
L4	CAM	Inductor .47 µh LT4K030	C2 Filtering
L5	CAM	Inductor 10 µh LT4K046	FL2 Filtering
L6	CAM	Inductor 10 µh LT4K046	C4 Filtering
L7	CAM	Inductor .47 µh LT4K030	C8 Tuning
L8		Inductor 2 turns 1/4" Diam. #18 wire	Q4 Collector
L9		Inductor 2 turns 1/4" Diam. #18 wire	Q1 Collector
L10		Inductor 4 turns 1/4" Diam. #18 wire	Q2 Collector
L11		Inductor 4 turns 1/4" Diam. #18 wire	Q3 Collector
L12		Inductor 4 turns 1/4" Diam. #18 wire	Q4 Collector
L13	CAM	Inductor .22 µh LT4K028	Q1 Collector
L14	CAM	Inductor 1 µh LT4K034	C10 Tuning
L15	CAM	Inductor 1 µh LT4K034	C16 Tuning
L16		Inductor 3 turns 1/4" Diam. #18 wire	C21 Tuning
L17	CAM	Inductor .47 µh LT4K030	Q4 Base
L18	CAM	Inductor .33 µh LT4K029	C19 Tuning
L19	CAM	Inductor 1 µh LT4K034	C25 Tuning
L20	CAM	Inductor 1 µh LT4K034	C24 Tuning
L21	CAM	Inductor .68 µh LT4K032	Q5 Base
L22		Inductor 2 turns 1/4" Diam. #18 wire	Q5 Collector
L23		Inductor 3 turns 1/4" Dian. #18 wire	C35 Tuning

TABLE 6-2. MAINTENANCE PART LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A3			
L24	CAM	Inductor .68 μh LT4K032	Q5 Base
L25		Inductor 2 turns 1/4" Diam. #18 wire	Q6 Collector
L26		Inductor 3 turns 1/4" Diam.#18 wire	C43 Tuning
L27	CAM	Inductor .68 μh LT4K032	Q6 Base
Q1	MOT	Transistor 2N3137	Band Pass Amplifier
Q2	MOT	Transistor 2N3137	1st R.F. Amplifier
Q3	MOT	Transistor 2N3137	2nd R.F. Amplifier
Q4	MOT	Transistor 2N3137	Buffer Amplifier
Q5	RCA	Transistor 2N3553	Mult. Chain Final Amplifier
Q6	RCA	Transistor 2N3866	Local Osc. Final Amplifier
R1	TI	Sensistor, Texas Inst. TM 1/4 5.6K 5.6K ± 10%	Q4 Base, Bias
R2	TI	Resistor, Fixed Film 10 Ω ± 1% 1/10 watt. RN55G10R0F	Q4 Collector, Damping
R3	IRC	Resitor, Fixed Film 10 K ± 5% 1/4 watt RL07AD103J	Q1 Base, Bias
R4	IRC	Resistor, Fixed Film 680 Ω ± 5% 1/4 watt RL07AD681J	Q1 Collector, Damping
R5	IRC	Resistor, Fixed Film 1.8 K ± 5% 1/4 watt RL07AD182J	Q2 Base, Bias
R6	IRC	Resistor, Fixed Film 2.2 K ± 5% 1/4 watt RL07AD222J	Q2 Collector, Damping
R7	IRC	Resistor, Fixed Film 1.8 K ± 5% 1/4 watt RL07AD182J	Q3 Base, Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A3			
R8	IRC	Resistor, Fixed Film 2.2 K ± 5% 1/4 watt RL07AD222J	Q3 Collector, Damping
R9	TI	Resistor, Fixed Film 15.4 Ω±1% 1/10 watt RN55G15R4F	R12 Decoupler Matching
R10	TI	Resistor, Fixed Film 10 Ω±1% 1/4 watt RN60G10R0F	Q4 Base, Suppressor
R11	TI	Resistor, Fixed Film 17.8 Ω±1% 1/10 watt RN55G17R8F	Q1 Base, Decoupling
R12	IRC	Resistor, Fixed Film 220 Ω±5% 1/4 watt RL07AD221J	R9 Matching
R13	IRC	Resistor, Fixed Film 4.7 K ± 5% 1/4 watt RL07AD472J	CR3 Filter
R14	IRC	Resistor, Fixed Film 2.2 K ± 5% 1/4 watt RL07AD222J	Q1 Base, Bias
R15	IRC	Resistor, Fixed Film 68 Ω ± 5% 1/4 watt RL07AD680J	Q1 Emitter, Bias
R16	IRC	Resistor, Fixed Film 3.3 K ± 5% 1/4 watt RL07AD332J	CR3 Anode, Bias
R17	IRC	Resistor, Fixed Film 1 K ± 5% 1/4 watt RL07AD102J	Q2 Base, Bias
R18	IRC	Resistor, Fixed Film 180 Ω ± 5% 1/4 watt RL07AD181J	Q2 Emitter, Bias
R19	IRC	Resistor, Fixed Film 1 K ± 5% 1/4 watt RL07AD102J	Q3 Base, Bias
R20	IRC	Resistor, Fixed Film 180 Ω ± 5% 1/4 watt RL07AD181J	Q3 Emitter, Bias
R21	IRC	Resistor, Fixed Film 33 K ± 5% 1/4 watt RL07AD333J	CR6 Filter
R22	IRC	Resistor, Fixed Film 3.3 K ± 5% 1/4 watt RL07AD332J	CR6 Cathode, Bias
R23	IRC	Resistor, Fixed Film 220 Ω ± 5% 1/4 watt RL07AD221J	Q4 Base, Bias
R24	TI	Sensistor Texas Inst. TM 1/4 - 120 Ω 120 Ω ± 10%	R25, Temp. compens. attenuation

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A3			
R25	TI	Resistor, Fixed Film 38.3 Ω ± 1% 1/10 watt RN55G38R3F	C13, Attenuation
R26	TI	Sensistor Texas Inst. TM 1/4 -8.2 K 8.2 K ± 10%	Q5 Base Bias, Temp. Compens.
R27	IRC	Resistor, Fixed Film 470 Ω ± 5% 1/4 watt RL07AD471J	Q5 Collector, Damping
R28	IRC	Resistor, Fixed Film 68 K ± 5% 1/4 watt RL07AD683J	CR7 Anode, filter
R29	IRC	Resistor, Fixed Film 3.3 K ± 5% 1/4 watt RL07AD332J	CR7 Cathode, Bias
R30	IRC	Resistor, Fixed Film 220 ± 5% 1/4 watt RL07AD221J	Q5 Base, Bias
R31	TI	Sensistor Texas Inst. TM 1/4 -5.6K 5.6 K ± 10%	CR8 Cathode, Bias
R32	OHM	Resistor, Fixed, Composition 56 Ω ± 5% RC32GF560J	C37 Filtering
R33	TI	Sensistor Texas Inst. TM 1/4 -5.6 K 5.6 K ± 10%	Q6 Base, Bias Temp. Compens.
R34	IRC	Resistor, Fixed Film 470 ± 5% 1/4 watt RL07AD471J	Q6 Collector, Damping
R35	TI	Resistor, Fixed Film 24.9 ± 1% 1/10 watt RN55D24R9F	L26 Attenuation
R36	TI	Sensistor Texas Inst. TM 1/4 -8.2 K 8.2 K ± 10%	CR9 Cathode, Bias
R37	IRC	Resistor, Fixed Film 220 ± 5% 1/4 watt RL07AD221J	Q6 Base, Bias
T1	MTK	Transformer Montek Drawing C002698	First Doubler
T2	MTK	Transformer Montek Drawing C002698	Second Doubler

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A3A2		CRYSTAL CONTROLLED OSCILLATOR	C00367; Figs 5-29, -30,-31,-51
C1	CD	Capacitor Mica Dielectric 220 pf ± 5% 500V CM05D221J03	R1 Filtering
C2	CD	Capacitor Mica Dielectric 1000 pf ± 10% 500V DCW CB60RD102K	L1 Filtering
C3	CD	Capacitor Mica Dielectric 500 pf ± 10% 500V DCW CB60RD501K	L2 Filtering
C4	CD	Capacitor Mica Dielectric 500 pf ± 10% 500V DCW CB60RD501K	L3 Filtering
C5	SPR	Capacitor Solid Electrolyte (Tantalum) 6.8 µf ± 10% 35V DCW CS13BF685K	R2 Filtering
C6	CD	Capacitor Mica Dielectric 220 pf ± 5% 500V DCW CM05D221J03	R7 Coupling
C7	ERIE	Capacitor Ceramic Dielectric 680 pf ± 20% 1000V CK60AW681M	Q2 Base Coupling
C8	ERIE	Capacitor Ceramic Dielectric 680 pf ± 20% 1000V CK60AW681M	R5 RF Bypass
C9	CD	Capacitor Mica Dielectric 5 pf ± 10% 500V DCW CM05C050K03	L7 Coupling
C10	ERIE	Capacitor Ceramic Dielectric 680 pf ± 20% 1000V CK60AW681M	R6 RF Bypass
C11	CD	Capacitor Mica Dielectric 39 pf ± 5% 500V DCW CM05D390J03	L8 Coupling
C12	ERIE	Capacitor Variable 5.5--18 pf 200V DCW Erie #538-016 92R	L7 Coupling
C13	ERIE	Capacitor Variable 5.5--18 pf 200V DCW Erie #538-016 92R	L8 Coupling
C14	JHN	Capacitor Variable 1--14 pf Johanson #3901	L4 Tuning
C15	CD	Capacitor Mica Dielectric 18 pf ± 10% 500V DCW CM05C180K03	L4 Feedback
C16	ERIE	Capacitor Ceramic Dielectric 680 pf ± 20% 1000V CK60AW681M	R10 RF Bypass

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION		LOCATING FUNCTION
1A2A1A3A2				
C17	CD	Capacitor Mica Dielectric 100 pf ± 5% 500V DCW CM05D101J03		L4 Feedback
C18	CD	Capacitor Mica Dielectric 22 pf ± 5% 500V DCW CM05D220J03		L6 Tuning
C19	ERIE	Capacitor Variable 5.5--18 pf 200V DCW Erie #538-016 92R		L6 Tuning
CR1	T1	Diode	IN914	R1 Rectifier
FL4	ERIE	Erie Part #1201-052		Meter Circuit Filtering
L1	CAM	Inductor 3.3 µh	LT4K040	C2 Filtering
L2	CAM	Inductor 3.3 µh	LT4K040	C3 Filtering
L3	CAM	Inductor 22 µh	LT4K050	C4 Filtering
L4	MTK	Inductor	Montek DWG C002697-1	Q1 Collector
L5	CAM	Inductor .68 µh	LT4K032	Q2 Collector Load
L6	CAM	Inductor .68 µh	LT4K032	Q3 Collector
L7	MTK	Inductor	Montek DWG C002697-2	Q2 Collector, Coupling
L8	MTK	Inductor	Montek DWG C002697-3	Q3 Collector, Coupling
L9	CAM	Inductor 3.3 µh	LT4K040	Q3 Base Return
L10	CAM	Inductor 1.5 µh	LT4K036	Y1 Compensating

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A3A2			
Q1	TI	Transistor 2N918	Oscillator
Q2	MOT	Transistor 2N2219	Buffer
Q3	MOT	Transistor 2N2219	Output
R1	IRC	Resistor Fixed Film 4.7 K ± 5% 1/4 watt RL07AD472J	C1 Filtering
R2	IRC	Resistor Fixed Film 4.7 K ± 5% 1/4 watt RL07AD472J	Q1 Base Bias
R3	IRC	Resistor Fixed Film 2.7 K ± 5% 1/4 watt RL07AD272J	L4 Damping
R4	IRC	Resistor Fixed Film 3.3 K ± 5% 1/4 watt RL07AD332J	Q2 Base Bias
R5	IRC	Resistor Fixed Film 120 Ω ± 5% 1/4 watt RL07AD121J	Q2 Collector Resistor
R6	IRC	Resistor Fixed Film 120 Ω ± 5% 1/4 watt RL07AD121J	Q3 Collector Resistor
R7	TI	Resistor Fixed Film 20.3 Ω ± 1% 1/10 watt RN55C20R3F	R12 Matching
R8	IRC	Resistor Fixed Film 56 Ω ± 5% 1/4 watt RL07AD560J	Q3 Base Series
R9	IRC	Resistor Fixed Film 100 Ω ± 5% 1/4 watt RL07AD101J	Q1 Base Series
R10	IRC	Resistor Fixed Film 4.7 K ± 5% 1/4 watt RL07AD472J	Q1 Base Bias
R11	IRC	Resistor Fixed Film 680 Ω ± 5% 1/4 watt RL07AD681J	Q1 Emitter
R12	IRC	Resistor Fixed Film 160 Ω ± 5% 1/4 watt RL07AD161J	R7 Matching
R13	IRC	Resistor Fixed Film 1.5 K ± 5% 1/4 watt RL07AD152J	Q2 Base Bias
R14	IRC	Resistor Fixed Film 100 Ω ± 5% 1/4 watt RL07AD101J	Q2 Emitter

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A3A2			
R15	IRC	Resistor Fixed Film 470 Ω ± 5% 1/4 watt RL07AD471J	Q3 Base Bias
Y1	SE	Crystal, CR77/u	

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A5A1		PRESELECTOR AND RF POWER AMPLIFIER SUBASSEMBLY	Figs 5-3,-54, 4-29, and 5-58
8600-9106	TRK	Preselector and RF Power Amplifier (Tubes: RCA 4062A)	
C1	GE	Capacitor Fixed Paper Dielectric 2 µf ±10% -1500 volts. CP70B1EH205K1	HV Filtering HV Filtering
R1	TI	Resistor, Fixed Film 10 Ω ± 1% 1/10 watt RN55D10R0F	V1 Bias
R2	TI	Resistor, Fixed Film 10 Ω ± 1% 1/10 watt RN55D10R0F	V2 Bias
R3	IRC	Resistor, Fixed Film 3.9 K ± 5% 1/4 watt RL02AD392J	Voltage Dropping
R4	IRC	Resistor, Fixed Film 270 Ω ± 5% 1/4 watt RL07AD271J	Current Limiting
R5	OHM	Resistor, Fixed Composition 560 Ω ± 5% 1 watt RC32GF561J	C1 Filtering
FL1	ITEL	Low Pass Filter I-TEL No. FLT/2-1200-13/50-11B(s)/11B(s)	Mounted On Support Bracket

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4		RECEIVER	E00403; Figs 5-35 thru 5-40, 5-44
C1	ERIE	Capacitor, Ceramic Dielectric 1500 pf ± 20% 500V DCW CK70AW152M	R3 Filtering
C2	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R1 RF Filtering
C3	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 1 µf ± 10% 35V DCW CS13BE105K	R1 Filtering
C4	ERIE	Capacitor, Fixed, Ceramic Dielectric 2 pf ± .25 pf 500V DCW CC20CK020C	R4 Coupling
C5	CD	Capacitor, Fixed, Mica Dielectric 5 pf ± 10% 500V DCW CM05C050K03	R7 Coupling
C6	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R2 RF Filtering
C7	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	L3 Coupling
C8	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R3 RF Filtering
C9	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	CR2 Coupling
C10	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	L1 Tuning
C11	ERIE	Capacitor, Variable, Ceramic 5.5 - 18 pf 200V DCW Erie 538-016 92R	L1 Tuning
C12	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	T1 Tuning
C13	ERIE	Capacitor, Variable, Ceramic 5.5 - 18 pf 200V DCW Erie 538-016 92R	T1 Tuning
C14	ERIE	Capacitor, Variable, Ceramic 5.5 - 18 pf 200V DCW Erie 538-016 92 R	L2 Tuning
C15	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	L2 Tuning
C16	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	T2 Tuning

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4			
C17	ERIE	Capacitor, Variable, Ceramic 5.5 - 18 pf 200V DCW Erie 538-016 92R	T2 Tuning
C18	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	L5 Coupling
C19	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	T1 Coupling
C20	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	T2 Coupling
C21	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	L5 Coupling
C22	ERIE	Capacitor, Variable, Ceramic 5.5 - 18 pf 200V DCW Erie 538-016 92R	L5 Impedance Matching
C23	ERIE	Capacitor, Variable, Ceramic 5.5 - 18 pf 200V DCW Erie 538-016 92R	L5 Impedance Matching
C24	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	Q1 Emitter Bypass
C25	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	Q2 Emitter Bypass
C26	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 2.2 µf ± 10% 20V DCW CS13BE225K	Q2 Emitter Bypass
C27	CD	Capacitor, Fixed, Mica Dielectric 500 pf ± 10% 500V DCW CB60RD501K	Q2 Emitter Filtering
C28	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R30 Filtering
C29	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ± 10% 20V DCW CS13BE156K	Q3 Emitter Bypass
C30	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	Q4 Emitter Bypass
C31	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ± 10% 20V DCW CS13BE156K	Q4 Emitter Bypass
C32	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	L6 RF Filtering
C33	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf 500V DCW CK61CZ471K	L7 RF Filtering

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4			
C34	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R31 Filtering
C35	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R32 Filtering
C36	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R33 Filtering
C37	ERIE	Capacitor, Fixed, Ceramic Dielectric 1500 pf ± 20% 500V DCW CK70AW152M	R27 RF Filtering
C38	ERIE	Capacitor, Fixed, Ceramic Dielectric 1500 pf ± 20% 500V DCW CK70AW152M	R28 RF Filtering
C39	ERIE	Capacitor, Fixed, Mica 500 pf ± 10% 500V DCW CB60RD501K	R36 Filtering
C40	ERIE	Capacitor, Fixed, Ceramic Dielectric 680 pf ± 20% 1000V DCW CK60AW681M	R35 Filtering
C41	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 47 µf ± 10% 35V DCW CS13BF476K	R36 Filtering
C42	JHN	Capacitor, Variable, Ceramic .4 - 6 pf 250V DCW Johanson 4640	L13 Coupling
C43	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	Q6 Base Coupling
C44	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	Q8 Base Coupling
C45	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	Q9 Base Coupling
C46	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ± 10% 20V DCW CS13BE156K	R37 Decoupling
C47	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ± 10% 20V DCW CS13BE156K	Q12 Base Coupling
C48	ERIE	Capacitor, Variable 5.5 - 18 pf 200V DCW Erie 538-016 92R	Q9 Collector Tuning
C49	CD	Capacitor, Fixed, Mica Dielectric 68 pf ± 5% 500V DCW CM05D680J03	L13 Tuning
C50	CD	Capacitor, Fixed, Mica Dielectric 10 pf ± 10% 500V DCW CM05C100K03	R59 RF Filtering

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4			
C51	JOH	Capacitor, Variable 1.7 f- 20 pf Johanson 193-6-5	L14 Tuning
C52	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	L14 Tuning
C53	CD	Capacitor, Fixed, Mica Dielectric 150 pf ± 5% 500V DCW CM05D151J03	L14 Tuning
C54	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 1 µf ± 10% 20V DCW CS13BE105K	Q10 Base Coupling
C55	CD	Capacitor, Fixed, Mica Dielectric 180 pf ± 5% 500V DCW CM05D181J03	L14 Tuning
C56	CD	Capacitor, Fixed, Mica Dielectric 68 pf ± 5% 500V DCW CM05D680J03	CR8 Cathode, RF Bypass
C57	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 1 µf ± 10% 20V DCW CS13BE105K	R61 DC Blocking
C58	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ± 10% 20V DCW CS13BE156K	Q13 Base Coupling
C59	CD	Capacitor, Fixed, Mica Dielectric 10 pf ± 10% 500V DCW CM05C100K03	L10 Tuning
C60	CD	Capacitor, Fixed, Mica Dielectric 47 pf ± 5% 500V DCW CM05D470J03	Q7 Base Coupling
C61	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 10 µf ± 10% 20V DCW CS13BE106K	Q11 Base Coupling
C62	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R88 RF Bypass
C63	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R89 RF Bypass
C64	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ± 10% 20V DCW CS13BE156K	R89 Bypass
C65	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R90 RF Bypass
C66	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ± 10% 20V DCW CS13BE156K	R90 Bypass
C67	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R91 RF Bypass

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4			
C68	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ± 10% 20V DCW CS13BE156K	R91 Bypass
C69	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R92 RF Bypass
C70	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 15 µf ± 10% 20V DCW CS13BE156K	R92 Bypass
C71	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R93 Decoupling
C72	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R94 Decoupling
C73	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R95 Decoupling
C74	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	R96 Decoupling
C75	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	L16 Decoupling
C76	ERIE	Capacitor, Fixed, Mica Dielectric 500 pf ± 10% 500V DCW CB60RD501K	-12.6 Filtering
C77	ERIE	Capacitor, Fixed, Ceramic Dielectric 470 pf ± 10% 500V DCW CK61CZ471K	L17 Filtering
C78	SPR	Capacitor, Fixed, Solid Electrolyte (Tantalum) 1300 µf 20V DCW CL53CF132UP3	R97 Filtering
CR1	SYL	Diode IN82AG	R8 Shaping
CR2	SYL	Diode IN82AG	R14 Shaping
CR3	TI	Diode IN914	R59 Video Detector
CR4	SYL	Diode IN82AG	R47 Shaping
CR5	SYL	Diode IN82AG	R50 Shaping
CR6	SYL	Diode IN82AG	R53 Shaping
CR7	TI	Diode IN914	R56 Shaping
CR8	TI	Diode IN914	R75 Video Detector

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4			
CR9	SYL	Diode IN82AG	R78 Clipping
CR10	TI	Diode IN914	R85 Clipping
CR11	TI	Diode IN914	R85 Clipping
L1	MTK	Inductor, Montek Drawing C002699-2	Q1 Collector Tuning
L2	MTK	Inductor, Montek Drawing C002699-2	Q2 Collector Tuning
L3	CAM	Inductor, .33 µh LT4K029	Q3 Collector Tuning
L4	CAM	Inductor, .33 µh LT4K029	Q4 Collector Tuning
L5	CAM	Inductor, .33 µh LT4K029	Q1 Base Filter
L6	CAM	Inductor, 3.3 µh LT4K040	R27 Meter Filtering
L7	CAM	Inductor, 3.3 µh LT4K040	R28 Meter Filtering
L8	CAM	Inductor, 1.0 µh LT4K034	R38 RF Blocking
L9	CAM	Inductor, .33 µh LT4K029	Q5 Collector Tuning
L10	CAM	Inductor, .33 µh LT4K029	Q6 Collector Tuning
L11	CAM	Inductor, .33 µh LT4K029	Q7 Collector Tuning
L12	CAM	Inductor, .33 µh LT4K029	Q8 Collector Tuning
L13	MTK	Inductor, Montek Drawing C00269-3	Q9 Collector Tuning
L14	JFD	Inductor, .06 µh JFD LF4W006	C51 Tuning
L15	CAM	Inductor, 3.3 µh LT4K040	Q11 Base RF Blocking
L16	CAM	Inductor, 3.3 µh LT4K040	R87 RF Blocking
L17	CAM	Inductor, 3.3 µh LT4K040	C76 RF Blocking
Q1	TI	Transistor, 2N918	IF Amplifier
Q2	TI	Transistor, 2N918	IF Amplifier
Q3	TI	Transistor, 2N918	IF Amplifier

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4			
Q4	TI	Transistor, 2N918	IF Amplifier
Q5	TI	Transistor, 2N918	IF Amplifier
Q6	TI	Transistor, 2N918	IF Amplifier
Q7	TI	Transistor, 2N918	IF Amplifier
Q8	TI	Transistor, 2N918	IF Amplifier
Q9	TI	Transistor, 2N918	Ferris Discriminator Driver
Q10	TI	Transistor, 2N706	Emitter Follower
Q11	TI	Transistor, 2N706	Video Amplifier
Q12	TI	Transistor, 2N1893	Video Amplifier
Q13	MOT	Transistor, 2N2222	Emitter Follower
R1	IRC	Resistor, Fixed, Film 560 Ω ± 5% 1/4 Watt RL07AD561J	C2 Filtering
R2	IRC	Resistor, Fixed, Film 220 Ω ± 5% 1/4 Watt RL07AD221J	C6 Filtering
R3	IRC	Resistor, Fixed, Film 220 Ω ± 5% 1/4 Watt RL07AD221J	C8 Filtering
R4	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	Collector Q1 Damping
R5	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	C12 Damping
R6	IRC	Resistor, Fixed, Film 8.2 K ± 5% 1/4 Watt RL07AD822J	Q2 Base Bias
R7	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	Collector Q2 Damping
R8	IRC	Resistor, Fixed, Film 560 Ω ± 5% 1/4 Watt RL07AD561J	CR1 Cathode, Shaping
R9	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	C16 Damping

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4			
R10	IRC	Resistor, Fixed, Film 3.9 K ± 5% 1/4 Watt RL07AD392J	Q3 Base Bias
R11	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	Collector Q3 Damping
R12	IRC	Resistor, Fixed, Film 4.7 K ± 5% 1/4 Watt RL07AD472J	Q4 Base Bias
R13	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	Collector Q4 Damping
R14	IRC	Resistor, Fixed, Film 560 Ω ± 5% 1/4 Watt RL07AD561J	CR2 Cathode, Shaping
R15	IRC	Resistor, Fixed, Film 22 K ± 5% 1/4 Watt RL07AD223J	Q1 Base Bias
R16	IRC	Resistor, Fixed, Film 6.8 K ± 5% 1/4 Watt RL07AD682J	Q1 Base Bias
R17	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	Q1 Emitter
R18	IRC	Resistor, Fixed, Film 2.2 K ± 5% 1/4 Watt RL07AD222J	Q2 Base Bias
R19	IRC	Resistor, Fixed, Film 560 Ω ± 5% 1/4 Watt RL07AD561J	Q2 Emitter
R20	IRC	Resistor, Fixed, Film 1.5 K ± 5% 1/4 Watt RL07AD152J	Q3 Base Bias
R21	TI	Resistor, Fixed, Film 22.6 Ω ± 1% 1/10 Watt RN55C22R6F	Q3 Emitter
R22	IRC	Resistor, Fixed, Film 1.5 K ± 5% 1/4 Watt RL07AD152J	Q4 Base Bias
R23	TI	Resistor, Fixed, Film 22.6 Ω ± 1% 1/10 Watt RN55C22R6F	Q4 Emitter
R24	IRC	Resistor, Fixed, Film 1.5 K ± 5% 1/4 Watt RL07AD152J	Q3 Emitter
R25	IRC	Resistor, Fixed, Film 1.5 K ± 5% 1/4 Watt RL07AD152J	Q4 Emitter
R26	IRC	Resistor, Fixed, Film 150 Ω ± 5% 1/4 Watt RL07AD151J	Mixer Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4			
R27	IRC	Resistor, Fixed, Film 150 Ω ± 5% 1/4 Watt RL07AD151J	Mixer Meter
R28	IRC	Resistor, Fixed, Film 150 Ω ± 5% 1/4 Watt RL07AD151J	Mixer Meter
R29	IRC	Resistor, Fixed, Film 150 Ω ± 5% 1/4 Watt RL07AD151J	Mixer Bias
R30	IRC	Resistor, Fixed, Film 220 Ω ± 5% 1/4 Watt RL07AD221J	C27 Decoupling
R31	IRC	Resistor, Fixed, Film 220 Ω ± 5% 1/4 Watt RL07AD221J	C34 Decoupling
R32	IRC	Resistor, Fixed, Film 220 Ω ± 5% 1/4 Watt RL07AD221J	C35 Decoupling
R33	IRC	Resistor, Fixed, Film 220 Ω ± 5% 1/4 Watt RL07AD221J	C36 Decoupling
R34	IRC	Resistor, Fixed, Film 150 K ± 5% 1/4 Watt RL07AD154J	C40 Voltage Dropping
R35	IRC	Resistor, Fixed, Film 330 K ± 5% 1/2 Watt RL20AD334J	C40 Voltage Dropping
R36	OHM	Resistor Fixed, Composition 10 Ω ± 5% 1/4 Watt RC07GF100J	C41 Filtering
R37	IRC	Resistor, Fixed, Film 1.2 K ± 5% 1/4 Watt RL07AD122J	C46 Decoupling
R38	IRC	Resistor, Fixed, Film 330 Ω ± 5% 1/4 Watt RL07AD331J	CR8 DC Return
R39	IRC	Resistor, Fixed, Film 33 K ± 5% 1/4 Watt RL07AD333J	Q10 Base Bias
R40	IRC	Resistor, Fixed, Film 27 K ± 5% 1/4 Watt RL07AD273J	Q11 Base Bias
R41	MIN	Resistor, Variable 500 Ω MINELCO MF2S 5C	Collector Q11 Pickoff
R42	TI	Sensistor 8.2 K Texas Instrument TM 1/4-8.2K	Q12 Base Bias
R43	TI	Sensistor 270 Ω Texas Instrument TM 1/4-270 Ω	Q12 Collector

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4			
R44	IRC	Resistor, Fixed, Film 10 K ± 5% 1/4 Watt RL07AD103J	CR11 Bias
R45	IRC	Resistor, Fixed Film 3.9 K ± 5% 1/4 Watt RL07AD392J	Q5 Base Bias
R46	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	Q5 Collector Damping
R47	MIN	Resistor, Variable 500 Ω MINELCO MF2S 5C	CR4 Anode, Shaping
R48	IRC	Resistor, Fixed, Film 3.9 K ± 5% 1/4 Watt RL07AD392J	Q6 Base Bias
R49	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	Q6 Collector Damping
R50	MIN	Resistor, Variable 500 Ω MINELCO MF2S 5C	CR5 Anode, Shaping
R51	IRC	Resistor, Fixed, Film 3.9 K ± 5% 1/4 Watt RL07AD392J	Q7 Base Bias
R52	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	Q7 Collector Damping
R53	MIN	Resistor, Variable 500 Ω MINELCO MF2S 5C	CR6 Anode, Shaping
R54	IRC	Resistor, Fixed, Film 3.9 K ± 5% 1/4 Watt RL07AD392J	Q8 Base Bias
R55	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	Q8 Collector Damping
R56	MIN	Resistor, Variable 500 Ω MINELCO MF2S 5C	CR7 Anode, Shaping
R57	IRC	Resistor Fixed, Film 3.3 K ± 5% 1/4 Watt RL07AD332J	Q9 Base Bias
R58	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	Q9 Collector Damping
R59	IRC	Resistor, Fixed, Film 4.7 K ± 5% 1/4 Watt RL07AD472J	CR3 Anode, Shaping
R60	IRC	Resistor, Fixed, Film 27 K ± 5% 1/4 Watt RL07AD273J	CR8 Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4			
R61	IRC	Resistor, Fixed, Film 100 Ω ± 5% 1/4 Watt RL07AD101J	Q10 Base Limiting
R62	IRC	Resistor, Fixed, Film 10 K ± 5% 1/4 Watt RL07AD103J	Q12 Base Bias
R63	IRC	Resistor, Fixed, Film 1.2 K ± 5% 1/4 Watt RL07AD122J	Q12 Collector
R64	IRC	Resistor, Fixed, Film 56 Ω ± 5% 1/4 Watt RL07AD560J	Q9 Base Limiting
R65	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	Q13 Emitter Output
R66	IRC	Resistor, Fixed, Film 1.5 K ± 5% 1/4 Watt RL07AD152J	Q5 Base Bias
R67	MIN	Resistor, Variable 100 Ω MINELCO MF2S 1C	Q5 Emitter Gain Control
R68	IRC	Resistor, Fixed, Film 1.5 K ± 5% 1/4 Watt RL07AD152J	Q6 Base Bias
R69	TI	Resistor, Fixed, Film 22.6 Ω ± 1% 1/10 Watt RN55C22R6F	Q6 Emitter
R70	IRC	Resistor, Fixed, Film 1.5 K ± 5% 1/4 Watt RL07AD152J	Q7 Base Bias
R71	TI	Resistor, Fixed, Film 22.6 Ω ± 1% 1/10 Watt RN55C22R6F	Q7 Emitter
R72	IRC	Resistor, Fixed, Film 1.5 K ± 5% 1/4 Watt RL07AD152J	Q8 Base Bias
R73	TI	Resistor, Fixed, Film 22.6 Ω±1% 1/10 Watt RN55C22R6F	Q8 Emitter
R74	IRC	Resistor, Fixed, Film 100 Ω ± 5% 1/4 Watt RL07AD101J	Q9 Emitter
R75	IRC	Resistor, Fixed Film 15 K ± 5% 1/4 Watt RL07AD153J	CR8 Cathode Bias
R76	IRC	Resistor, Fixed, Film 680 K ± 5% 1 Watt RL32AD684J	CR8 Cathode Bias
R77	OHM	Resistor, Fixed, Composition 1.5 M ± 5% 1/2 Watt RC20GF155J	CR9 Cathode Bias

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4			
R78	IRC	Resistor, Fixed, Film 22 K ± 5% 1/4 Watt RL07AD223J	CR9 Cathode Bias
R79	IRC	Resistor, Fixed Film 33 K ± 5% 1/4 Watt RL07AD333J	Q10 Base Bias
R80	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	Q10 Emitter
R81	IRC	Resistor, Fixed, Film 3.9 K ± 5% 1/4 Watt RL07AD392J	Q11 Base Bias
R82	IRC	Resistor, Fixed, Film 68 Ω ± 5% 1/4 Watt RL07AD6805	Q11 Emitter
R83	IRC	Resistor, Fixed, Film 3.9 K ± 5% 1/4 Watt RL07AD392J	Q12 Base Bias
R84	IRC	Resistor, Fixed, Film 220 Ω ± 5% 1/4 Watt RL07AD221J	Q12 Emitter
R85	IRC	Resistor, Fixed, Film 22 K ± 5% 1/4 Watt RL07AD223J	Q13 Base Bias
R86	IRC	Resistor, Fixed, Film 1 K ± 5% 1/4 Watt RL07AD102J	Q13 Emitter
R87	IRC	Resistor, Fixed, Film 2.7 K ± 5% 1/4 Watt RL07AD272J	Q9 Base Bias
R88	IRC	Resistor, Fixed, Film 220 Ω ± 5% 1/4 Watt RL07AD221J	Q9 Emitter
R89	IRC	Resistor, Fixed, Film 1.5 K ± 5% 1/4 Watt RL07AD152J	Q5 Emitter
R90	IRC	Resistor, Fixed, Film 1.5 K ± 5% 1/4 Watt RL07AD152J	Q6 Emitter
R91	IRC	Resistor, Fixed, Film 1.5 K ± 5% 1/4 Watt RL07AD152J	Q7 Emitter
R92	IRC	Resistor, Fixed, Film 1.5 K ± 5% 1/4 Watt RL07AD152J	Q8 Emitter
R93	IRC	Resistor, Fixed, Film 100 Ω ± 5% 1/4 Watt RL07AD101J	C71 Decoupling
R94	IRC	Resistor, Fixed, Film 100 Ω ± 5% 1/4 Watt RL07AD101J	C72 Decoupling

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4			
R95	IRC	Resistor, Fixed, Film 100 Ω ± 5% 1/4 Watt RL07AD101J	C73 Decoupling
R96	IRC	Resistor, Fixed, Film 100 Ω ± 5% 1/4 Watt RL07AD101J	C74 Decoupling
R97	OHM	Resistor, Fixed, Composition 10 Ω ± 10% 1/4 Watt RC07GF100K	C77 Decoupling
T1	MTK	Transformer, Montek Drawing C002699-1	IF Coupling
T2	MTK	Transformer, Montek Drawing C002699-1	IF Coupling

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4Z1		RECEIVER, MIXER ASSEMBLY	E00403; Fig 5-37
B002504	RLCE	Balanced Mixer, Model No. X-L-R (Modified)	
CR1	SYL	Diode IN21E	Mixer
CR2	SYL	Diode IN21ER	Mixer

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4A1		RECEIVER AUTOMATIC SENSITIVITY CONTROL	C00404; Figs 5-41, -45
C1	SPR	Capacitor, Fixed Solid Electrolyte (Tantalum) 220 µf ±10% 10V DCW CS13BC227K	CR1 anode, Output Filtering
C2	SPR	Capacitor, Fixed Solid Electrolyte (Tantalum) 15 µf ±10% 20V DCW CS13BE156K	R2, +12.6V Filtering
C3	CD	Capacitor, Fixed Mica Dielectric 820 pf ±5% 500V DCW CM06D821J03	Q3 Collector MV Timing
C4	CD	Capacitor, Fixed Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q2 Collector, Speed Up
C5	CD	Capacitor, Fixed Mica Dielectric 120 pf ±5% 500V DCW CM05D121J03	Q5 Base, Speed Up
C6	CD	Capacitor, Fixed Mica Dielectric 56 pf ±5% 500V DCW CM05D560J03	CR4 Cathode, Input Coupling
C7	SPR	Capacitor, Fixed Solid Electrolyte (Tantalum) 330 µf ±10% 6V DCW CS13BB337K	R13, Integrator
C8	SPR	Capacitor, Fixed Solid Electrolyte (Tantalum) 1 µf ±10% 35V DCW CS13BF105K	R24, -12.6V filtering
CR1	TI	Diode, IN914	Q1, Collector Clamping
CR2	TI	Diode, IN914	Q4, Collector Temp. Compensating
CR3	TI	Diode, IN914	Q2, Base Clamping
CR4	TI	Diode, IN914	Q2, Base Drive
CR5	MOT	Diode, IN823 Voltage Reference Diode	R8, Voltage Reference
E5	USC	Terminal, Stud USECO 2020B-1	+12.6 Volts
E6	USC	Terminal, Stud USECO 2020B-1	Input from Decoder
E7	USC	Terminal, Stud USECO 2020B-1	Deadtime Gate from Control
E8	USC	Terminal, Stud USECO 2020B-1	-12.6 Volts
E9	USC	Terminal, Stud USECO 2020B-1	MV Testpoint TP1

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4A1			
Q1	MOT	Transistor 2N1132	PNP, Driver
Q2	TI	Transistor 2N706	Multivibrator
Q3	TI	Transistor 2N706	Multivibrator
Q4	TI	Transistor 2N2060	Differential Amplifier
Q5	MOT	Transistor 2N2219	Integrator Driver
Q6	TI	Transistor 2N706	Multivibrator Inhibit Gate
R1	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	TP1, Terminal E9 Series Resistor
R2	OHM	Resistor, Fixed, Composition 10Ω ±10% 1/4 Watt RC07GF100K	C2, Filtering
R3	IRC	Resistor, Fixed, Film 10K ±5% 1/4 Watt RL07AD103J	C3, MV Timing
R4	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q2, Collector
R5	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	Q3, Collector
R6	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD471J	Q1, Emitter
R7	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q4, Collector 1
R8	IRC	Resistor, Fixed, Film 560Ω ±5% 1/4 Watt RL07AD561J	R10, Voltage Divider
R9	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q3 Base, Coupling
R10	IRC	Resistor, Fixed, Film 470Ω ±5% 1/4 Watt RL07AD471J	R8, Voltage Divider
R11	IRC	Resistor, Fixed, Film 5.6K ±5% 1/4 Watt RL07AD562J	CR4 Cathode
R12	IRC	Resistor, Fixed Film 2.2K ±5% 1/4 Watt RL07AD222J	Q5 Base
R13	IRC	Resistor, Fixed, Film 120Ω ±5% 1/4 Watt RL07AD121J	Q5 Collector

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A4A1 R14	IRC	Resistor, Fixed, Film 1.5K ±5% 1/4 Watt RL07AD152J	Q4 Base 1Series Resistor
R15	IRC	Resistor, Fixed, Film 2.2K ±5% 1/4 Watt RL07AD222J	Q4 Base 2 Series Resistor
R16	BRN	Resistor, Variable 500Ω Pot. Bourns 3260H-1-501	Squitter Rate Adjust
R17	IRC	Resistor, Fixed, Film 1K ±5% 1/4 Watt RL07AD102J	R16, Voltage Divider Network
R18	IRC	Resistor, Fixed, Film 4.7K ±5% 1/4 Watt RL07AD472J	C7, Bias Resistor
R19	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	Q6 Base Series Resistor
R20	IRC	Resistor, Fixed, Film 1.8K ±5% 1/4 Watt RL07AD182J	Q4 Emitter
R21	IRC	Resistor, Fixed, Film 2.7K ±5% 1/4 Watt RL07AD272J	R16, Voltage Divider Network
R22	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q6 Base Bias
R23	IRC	Resistor, Fixed, Film 18K ±5% 1/4 Watt RL07AD183J	Q3 Base Bias
R24	IRC	Resistor, Fixed, Film 39K ±5% 1/4 Watt RL07AD393J	Q5 Base Bias
R25	IRC	Resistor, Fixed, Film 100Ω ±5% 1/4 Watt RL07AD101J	-12.6 V Filtering

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A2A1A6		TEST METER CIRCUIT	B00417; Figs 5-55, 4-30
CR1	TI	Diode IN645	Meter Shunt
M1	MTK	Meter 100 μ Amp DC Montek DWG C000743	
R1	OHM	Resistor, Fixed Composition 3.3 K ± 5% 1/2 watt RC20GF332J	Meter Multiplier
R2	OHM	Resistor, Fixed Composition 3.9 K ± 5% 1/2 watt RC20GF392J	Meter Multiplier
R3	OHM	Resistor, Fixed Composition 240 K ± 5% 1/2 watt RC20GF244J	Meter Multiplier
R4	OHM	Resistor, Fixed Composition 5.6 K ± 5% 1/2 watt RC20GF562J	Meter Multiplier
R5	OHM	Resistor, Fixed Composition 39 K ± 5% 1/2 watt RC20GF393J	Meter Multiplier
R6	OHM	Resistor, Fixed Composition 820 Ω ± 5% 1/2 watt RC20GF821J	Meter Multiplier
R7	OHM	Resistor, Fixed Composition 33 K ± 5% 1/2 watt RC20GF333J	Meter Multiplier
R8	OHM	Resistor, Fixed Composition 430 K ± 5% 1/2 watt RC20GF434J	Meter Multiplier
R9	OHM	Resistor, Fixed Composition 130 K ± 5% 1/2 watt RC20GF134J	Meter Multiplier
R10	OHM	Resistor, Fixed Composition 240 K ± 5% 1/2 watt RC20GF244J	Meter Multiplier
R11	OHM	Resistor, Fixed Composition 470 K ± 5% 1/2 watt RC20GF474J	Meter Multiplier
R12	OHM	Resistor, Fixed Composition 68 K ± 5% 1/2 watt RC20GF683J	Meter Multiplier
S4	JBT	Switch, 12 pos. 2 pole, 2 deck 30° SR05N30C3MGC JBTV 71122N	Front panel, Meter Selector Switch

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
1A3A2		ALTERNATE POWER SUPPLY	C00368; Figs 5-57 thru 5-63
C1	GE	Capacitor, Fixed Electrolyte Electrolytic 150 µf 50V DCW CL25BJ151TP3	L1 Filtering
C2	GE	Capacitor, Fixed Electrolyte Electrolytic 150 µf 50V DCW CL25BJ151TP3	L1 Filtering
C3	GE	Capacitor, Fixed Electrolyte Electrolytic 150 µf 50V DCW CL25BJ151TP3	L1 Filtering
C4	GE	Capacitor, Fixed Electrolyte Electrolytic 150 µf 50V DCW CL25BJ151TP3	L1 Filtering
C5	GE	Capacitor, Fixed Electrolyte Electrolytic 150 µf 50V DCW CL25BJ151TP3	L1 Filtering
C6	GE	Capacitor, Fixed Electrolyte Electrolytic 150 µf 50V DCW CL25BJ151TP3	L1 Filtering
CR1	TI	Diode IN1614	Bridge Rectifier
CR2	TI	Diode IN1614	Bridge Rectifier
CR3	TI	Diode IN1614	Bridge Rectifier
CR4	TI	Diode IN1614	Bridge Rectifier
DS1	CM	Lamp Bulb MS25237-327	T1 Indicating
DS2	CM	Lamp Bulb MS25237-327	S3 Indicating
F1	LF	Fuse Slow Blow - 1 Amp. F02B250V1A	T1 Current Limiting
J1	BDX	Connector J1 MS3114E-10-6P	Input - Output J1 Connector

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION		LOCATING FUNCTION
1A3A2				
L1	MTK	Inductor 49 mil. henry Res $\leq$ 1 ohm. Montek DWG D000891		C1 Filtering
R1	DE	Resistor Fixed Wirewound 348 Ω ± 1% 10 watt	RE65G3480	C6 Filtering
R2	DE	Resistor Fixed, Film 330 Ω ± 5% 1 watt	RL32AD331J	DS1 Voltage Dropping
R3	DE	Resistor Fixed Wirewound 2.43 K Ω ± 1% 10 watt	RE65G2431	DS2 Voltage Dropping
S1	HET	Switch	Hetherington T2106	F1 Turn On - Off
S2	MS	Switch, Interlock	MS16106-1	S3 Interlock
S3	MS	Switch, Interlock	MS16106-1	S2 Interlock
T1	MTK	Transformer	Montek DWG D002351	F1 Voltage Transformer
TB1	CMC	Terminal Board 37TB10		J1 Tie Points
XDS1	MTK	Lamp Holder Red Indicating	Montek DWG C001046-1	T1 Indicating
XDS2	MTK	Lamp Holder Green Indicating	Montek DWG C001046-2	S3 Indicating
XF1	LF	Fuse Holder	FHL17G	T1 Current Limiting

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
		AN/TRN-22 (XN-1) CABLING INTER UNIT	Fig 2-6
W1	HWC	Cable, Hitemp Wire Co. 2TX20-1930 STJ	
P1	APM	Connector, Type UP121M	AC Input
P2	BDX	Connector, MS3116E-10-6S (SR)	Alt Pwr Supply
W2	HWC	Cable, Hitemp Wire Co. 2TX20-1930 STJ	
P1	BDX	Connector, MS3116E-10-6S (SR)	Transponder
P2	BDX	Connector, MS3116E-10-6S (SR)	Alt Pwr Supply
W3	HWC	Cable, Hitemp Wire Co. 2TX20-1930 STJ	
P1	BDX	Connector, MS3116E-10-6S (SR)	Transponder
P2	MTK	Connector, Montek #D002462	Battery
W4	NWC	Cable, National Wire NW-7263J	
P1	BDX	Connector, MS3116E-10-6P (SR)	Transponder
P2	BDX	Connector, MS3116E-10-6S	Antenna
P2	CE	90° Potting Plug, Cannon #KPT08P10-6S	Antenna

TABLE 6-2. MAINTENANCE PARTS LIST

REFERENCE DESIGNATION	NOTES	NAME AND DESCRIPTION	LOCATING FUNCTION
A5J4 A5J5		Cable, Supplied with Power Tube Assembly	Preselector
A5J6 A5J8		Cable, Supplied with Power Tube Assembly	Preselector
	AMP	Cable, RG188 1 3/4 ft	
A5J7	STC	Connector, UG-1465/u	Preselector
Card A1,E9		Connector, Solder terminal	Card Rack
A5J8 A5J9	MTK	Cable, Montek #B002661	Preselector
	AMP	Cable, RG188 5 11/32 in.	
A5J10	STC	Connector, UG-1465/u	Preselector
A5J11	STC	Connector, UG-1465/u	Preselector
A4J1 & J2	KE	Two TNC Elbow Adapters Kings KA-91-05	Receiver

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TYPE IIa

CHECK LIST FOR MANUSCRIPTS OF TECHNICAL MANUALS

CONTRACTOR LTV Electrosystems, Memcor/Montek Operation CONTRACT NUMBER(S) NObsr-95003

TITLE OF MANUAL Technical Manual for Transponder Set AN/TRN-22 (XN-1)

SECURITY CLASSIFICATION Unclassified

	YES	NO	NOT APPL
a. The manuscript consists of the following sub-divisions in the order indicated: Cover, Front Matter	(x)	( )	
Section 1 General Information			( )
Section 2 Installation			( )
Section 3 Operation			( )
Section 4 Trouble-Shooting			( )
Section 5 Maintenance			( )
Section 6 Parts List			( )
b. Front Matter			
Content and layout conform	(x)	( )	( )
Cover and Title Page	(x)	( )	
List of Effective Pages (loose-leaf books)	(x)	( )	( )
Table of Contents	(x)	( )	( )
Appropriate portion of Table of Contents appears at front of each volume (multi-volume books)	( )	( )	(x)
List of Illustrations	(x)	( )	( )
Appropriate portion of List of Illustrations appears at front of each volume (multi-volume books)	( )	( )	(x)
List of Tables	(x)	( )	( )
Appropriate portion of List of Tables appears at front of each volume (multi-volume books)	( )	( )	(x)
c. Section 1 - General Information			
Full page illustration on page 1-0	(x)	( )	
Supercession data & applicability of manual	(x)	( )	( )
Statement of model(s) covered	(x)	( )	
Functional description of set & of each unit	(x)	( )	
Information concerning field changes	( )	( )	(x)
Reference data	(x)	( )	
Tables:			
Equipment supplied	(x)	( )	
Equipment and publications required but not supplied	( )	( )	(x)
Field changes	( )	( )	(x)
Equipment similarities	( )	( )	(x)
d. Section 2 - Installation			
Instructions for unpacking & handling	(x)	( )	( )
Consideration for site selection	(x)	( )	( )
Power requirements (if external power is required)	(x)	( )	( )

	YES	NO	NOT APPL
Installation requirements:			
Installation pointers for set & for each unit	(x)	( )	( )
Outline drawings for each unit	( )	( )	(x)
Inspection & adjustment:			
Procedure for energizing set for first time	(x)	( )	( )
Procedure for making all required adjustments	(x)	( )	( )
Instructions for checking installation	(x)	( )	( )
Procedures to reduce radio interference	(x)	( )	( )
e. Section 3 - Operation			
Operating procedures:			
Sequence of operating procedures to accomplish each function including description of controls, indicator presentations, required tuning adjustments, and adequate warning and caution notices	(x)	( )	( )
f. Section 4 - Trouble Shooting			
Discussion level of Electronics Engineer	(x)	( )	
Overall functional block diagram, supplemented by a brief explanation	(x)	( )	
Functional block diagram of each "Functional Section," supplemented by an explanation	(x)	( )	
Clear explanations, with sketches of all new or unusual circuit arrangements, tubes, or test procedures	(x)	( )	
Simplified schematics (with wave shapes at indicated points when needed for understanding)	(x)	( )	
Test data	(x)	( )	
g. Section 5 - Maintenance			
Discussion level of Electronics Engineer	(x)	( )	( )
Calibration curves and other reference standards	(x)	( )	( )
Data on removal, adjustment, repair, & reassembly of parts and sub-assemblies	(x)	( )	( )
Exploded & cut-away views (when needed for maintenance)	( )	( )	(x)
Illustrations with call-outs, identifying all circuit elements	(x)	( )	( )
Adjustment & repair data:			
List of test equipment & special tools required	(x)	( )	( )
Procedure for making necessary adjustment or repair	(x)	( )	
Minimum acceptable standards	(x)	( )	( )
Procedures for reassembly	(x)	( )	( )
Connection diagrams or wire-running lists:			
For inter-unit connections	(x)	( )	( )
For intrarack connections	( )	( )	(x)
Power schematic diagram of primary power distribution, showing all items connected across primary supply	(x)	( )	
Overall schematic diagram of set (or individual functional section schematic diagrams) which includes:			
True functional layout	(x)	( )	
Reference designations conforming with MIL-STDS (unless equipment marked differently)	(x)	( )	
Electrical values of circuit elements	(x)	( )	

	YES	NO	NOT APPL
h. Section 6 - Parts List			
Introduction	(x)	( )	
List of Units (not required if less than 2 units)	(x)	( )	( )
Maintenance Parts List	(x)	( )	( )
List of Manufacturers	(x)	( )	( )
i. General Requirements			
Technical level of Electronics Engineer	(x)	( )	
Correct grammar, spelling, and punctuation	(x)	( )	
Consistent use of terminology through book	(x)	( )	
Sufficient notes, cautions, & warnings	(x)	( )	
Security classification of sections conform	( )	( )	(x)

I certify that the manuscript conforms to the statements as checked above and meets the requirements of the specification.

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